2005 Tri-Service Infrastructure Systems Conference & Exhibition

St. Louis, MO
"Re-Energizing Engineering Excellence"

2-4 August 2005

Agenda

***Panel**: The Future of Engineering and Construction*

- LTG Carl A. Strock, Commander, USACE
- Dr. James Wright, Chief Engineer, NAVFAC

***Panel**: USACE Engineering and Construction*

- Dr. Michael J. O'Connor, Director, R&D

***Panel**: Navy General Session*

- Mr. Steve Geusic, Engineering Criteria & Programs NAVFAC Atlantic

Introduction to Multi-Disciplinary Tracks, by Mr. Gregory W. Hughes
Engineering Circular: Engineering Reliability Guidance for Existing USACE Civil Works Infrastructure, by Mr. David M. Schaaf, PE, LRD Regional Technical Specialist, Navigation Engineering Louisville District
MILCON S&A Account Study, by Mr. J. Joseph Tyler, PE, Chief, Programs Integration Division, Directorate of Military Programs HQUSACE
Financial Justification on Bentley Enterprise License Agreement (ELA)

Track 1

- The Chicago Shoreline Storm Damage Reduction Project, by Andrew Benziger
- Protecting the NJ Coast Using Large Stone Seawalls, by Cameron Chasten
- Cascade: An Integrated Coastal Regional Model for Decision Support and Engineering Design, by Nicholas C. Kraus and Kenneth J. Connell
- Modeling Sediment Transport Along the Upper Texas Coast, by David B. King Jr., Jeffery P. Waters and William R. Curtis
- Sediment Compatibility for Beach Nourishment in North Carolina, by Gregory L. Williams
- Evaluating Beachfill Project Performance in the USACE Philadelphia District, by Monica Chasten and Harry Friebel
- US Army Corps of Engineers' National Coastal Mapping Program, by Jennifer Wozencraft
- Flood Damage Reduction Project Using Structural and Non-Structural Measures, by Stacey Underwood
- Shore Protection Project Performance Improvement Initiative (S3P2I), by Susan Durden
- Hurricane Isabel Post-Storm Assessment, by Jane Jablonski
- US Army Corps of Engineers Response to the Hurricanes of 2004, by Rick McMillen and Daniel R. Haubner
- Increased Bed Erosion Due to Increased Bed Erosion Due to Ice, by Decker B. Hains, John I. Remus, and Leonard J. Zabilansky
- Mississippi Valley Division, by James D. Gutshall
- Impacts to Ice Regime Resulting from Removal of Milltown Dam, Clark Fork River, Montana, by Andrew M. Tuthill and Kathleen D. White, and Lynn A. Daniels
- Carroll Island Micromodel Study: River Miles 273.0-263.0, by Jasen Brown
- Monitoring the Effects of Sedimentation from Mount St. Helens, by Alan Donner, Patrick O'Brien and David Biedenharn
  Watershed Approach to Stream Stability and Benefits Related to the Reduction of Nutrients, by John B. Smith
- A Lake Tap for Water Temperature Control Tower Construction at Cougar Dam, Oregon, by Stephen Schlenker, Nathan Higa and Brad Bird
- San Francisco Bay Mercury TMDL – Implications for Constructed Wetlands, by Herbert Fredrickson, Elly Best and Dave Soballe
- Abandoned Mine Lands: Eastern and Western Perspectives, by Kate White and Kim Mulhern
  Translating the Hydrologic Tower of Babel, byDan Crawford
- Demonstrating Innovative River Restoration Technologies: Truckee River, Nevada, by Chris Dunn
- System-Wide Water Resource Management – Tools of the Trade

Track 2

- Ecological and Engineering Considerations for Dam Decommissioning, Retrofits, and Reoperations, by Jock Conyngham
- Hydraulic Design of tidegates and other Water Control structures for Ecosystem Restoration projects on the Columbia River estuary, by Patrick S. O'Brien
- Surface Bypass & Removable Spillway Weirs, by Lynn Reese
- Impacts of using a spillway for juvenile fish passage on typical design criteria, by Bob Buchholz
- Howard Hanson Dam: Hydraulic Design of Juvenile Fish Passage Facility in Reservoir with Wide Pool Fluctuation, by Dennis Mekkers and Daniel M. Katz
- Current Research in Fate Current Research in Fate & Transport of Chemical and Biological Contaminants in Water Distribution Systems, by Vincent F. Hock
- Regional Modeling Requirements, by Maged Hussein
- Tools for Wetlands Permit Evaluation: Modeling Groundwater and Surface Water Interaction, by Cary Talbot
- Ecosystem Restoration for Fish and Wildlife Habitat on the UMRS, by Jon Hendrickson
- Missouri River Shallow Water Habitat Creation, by Dan Pridal
- Aquatic Habitat Restoration in the Lower Missouri River, by Chance Bitner
- Transition to an Oracle Based Data System (Corps Water Management System, CWMS), by Joel Asunskis
- RiverGages.com: The Mississippi Valley Division Water Control Website, by Rich Engstrom
- HEC-ResSim 3.0: Enhancements and New Capabilities, by Fauwaz Hanbali
- Hurricane Season 2004 – Not to Be Forgotten, by Jacob Davis
- Re-Evaluation of a Flood Control Project, by Ferris W. Chamberlin
- Helmand Valley Water Management Plan, by Jason Needham
- A New Approach to Water Management Decision Making, by James D. Barton
- Developing Reservoir Operational Plans to Manage Erosion and Sedimentation during Construction – Willamette Temperature
- Control, Cougar Reservoir 2002-2005, by Patrick S. O'Brien
- Improved Water Supply Forecasts for the Kootenay Basin, by Randal T. Wortman
- ResSIM Model Development for Columbia River System, by Arun Mylvahanan
- Prescriptive Reservoir Modeling and the ROPE, by Jason Needham
- Missouri River Basin Water Management, by Larry Murphy

Track 3

- Corps Involvement in FEMA's Map Modernization Program, by Kate White, John Hunter and Mark Flick
- Innovative Approximate Study Method for FEMA Map Moderniation Program , by John Hunter
- Flood Fighting Structures Demonstration and Evaluation Program (FFSD), by Fred Pinkard
- Integrating Climate Dynamics Into Water Resources Planning and Management, by Kate White
- Hydrologic and Hydraulic Contributions to Risk and Uncertainty Propagation Studies, by Robert Moyer
- Uncertainty Analysis: Parameter Estimation, by Jackie P. Hallberg
- Geomorphology Study of the Middle Mississippi River, by Eddie Brauer
- Bank Erosion and Morphology of the Kaskaskia River, by Michael T. Rodgers
- Degradation of the Kansas City Reach of the Missouri River, by Alan Tool
- Sediment Impact Assessment Model (SIAM), by David S. Biedenharn and Meg Jonas
- Mississippi River Sedimentation Study, by Basil Arthur
- Sediment Model of Rivers, by Charlie Berger
- East Grand Forks, MN and Grand Forks, ND Local Flood Damage Reduction Project, by Michael Lesher
- Hydrologic and Hydraulic Analyses, by Thomas R. Brown
- Hydrologic and Hydraulic Modeling of the Mccook and Thornton Tunnel and Reservoir Plans, by David Kiel
- Ala Wai Canal Project, by Lynnette F. Schaper
- Missouri River Geospatial Decision Support Framework, by Bryan Baker and Martha Bullock
- Systemic Analysis of the Mississippi & Illinois Rivers Upper Mississippi River Comprehensive Plan, by Dennis L. Stephens

Section 227: National Shoreline Erosion Control Demonstration and Development Program Annual Workshop

- Workshop Objectives
- Section 227: Oil Piers, Ventura County, CA, by Heather Schlosser
- An Evaluation of Performance Measures for Prefabricated Submerged Concrete Breakwaters: Section 227 Cape May Point, New Jersey Demonstration Project, by Donald K Stauble, J.B. Smith and Randall A. Wise
- Bluff Stabilization along Lake Michigan, using Active and Passive Dewatering Techniques, by Rennie Kaunda, Eileen Glynn, Ron Chase, Alan Kehew, Amanda Brotz and Jim Selegean
- Storm Damage at Cape Lookout
- Branchbox Breakwater Design at Pickleweed Trail, Martinez, CA
- Section 227: Miami, FL
- Section 227: Sheldon Marsh Nature Preserve
- Section 227: Seabrook, New Hampshire
- Jefferson County, TX – Low Volume Beach Fill
- Sacred Falls, Oahsacred Falls, Oahu Section 227 Demonstration Project

Track 4

- Fern Ridge LakFern Ridge Lake Hydrologic Aspects of Operation during Failure, by Bruce J Duffe
- A Dam Safety Study Involving Cascading Dam Failures, by Gordon Lance
- Spillway Adequacy Analysis of Rough River Lake Louisville District, by Richard Pruitt
- Water Management in Iraq: Capability and Marsh Restoration, by Fauwaz Hanbali
- Iraq Ministry of Water Resources Capacity Building, by Michael J. Bishop, John W. Hunter, Jeffrey D. Jorgeson, Matthew M. McPherson, Edwin A. Theriot, Jerry W. Webb, Kathleen D. White, and Steven C. Wilhelms

- HEC Support of the CMEP Program, by Mark Jensen
- Geospatial Integration of Hydrology & Hydraulics Tools for Multi-Purpose, Multi-Agency Decision Support, by Timothy Pangburn, Joel Schlagel, Martha Bullock, Michael Smith, and Bryan Baker
- GIS & Surveying to Support FEMA Map Modernization and Example Bridge Report, by Mark Flick
- High Resolution Bathymetry and Fly-Through Visualization, by Paul Clouse
- Using GIS and HEC-RAS for Flood Emergency Plans, by Stephen Stello
- High Resolution Visualizations of Multibeam Data of the Lower Mississippi River, by Tom Tobin and Heath Jones
- System Wide Water Resources Program Unifying Technologies Geospatial Applications, by Andrew J. Bruzewicz
- Raystown Plate Locations
- Hydrologic Engineering Center: HEC–HMS Version 3.0 New Features, by Jeff Harris
- SEEP2D & GMS: Simple Tools for Solving a Variety of Seepage Problems, by Clarissa Hansen, Fred Tracy, Eileen Glynn, Cary Talbot and Earl Edris
- Sediment and Water Quality in HEC-RAS, by Mark Jensen
- Advances to the GSSHA Model, by Aaron Byrd and Cary Talbot
- Watershed Analysis Tool: HEC-WAT Program, by Chris Dunn
- Little Calumet River UnsteadLittle Calumet River Unsteady Flow Model Conversion UNET to HEC-RAS, by Rick D. Ackerson
  Kansas River Basin Model, by Edward Parker
- Design Guidance for Breakup Ice Control Structures, by Andrew M. Tuthill
- Computational Hydraulic Model of the Lower Monumental Dam Forebay, by Richard Stockstill, Charlie Berger, John Hite, Alex Carrillo, and Jane Vaughan
- Use of Regularization as a Method for Watershed Model Calibration, by Brian Skahill
- Demonstration Program Urban Flooding and Channel Restoration in Arid and Semi-Arid Regions (UFDP), by Joan Pope, Jack Davis, Ed Sing, John Warwick, Meg Jonas

Track 5

- Walla Walla District Northwestern Division, by Robert Berger
- Best Practices for Conduits through Embankment Dams, by Chuck R. Cooper
- Design, Construction Design, Construction and Seepage at Prado Dam, by Douglas E. Chitwood
- 2-D Liquefaction Evaluation with Q4Mesh, by David C. Serafini
- Unlined Spillway Erosion Risk Assessment, by Johannes Wibowo, Don Yule, Evelyn Villanueva and Darrel Temple
- Seismic Remediation of the Clemson Upper and Lower Diversion Dams; Evaluation, Conceptual Design and Design, by Lee Wooten and Ben Foreman
- Seismic Remediation of the Clemson Upper and Lower Diversion Dams; Deep Soil Mix Construction, by Lee Wooten and Ben Foreman
- Historical Changes in the State of the Art of Seismic Engineering and Effects of those changes on the Seismic Response Studies of Large Embankment Dams, by Sam Stacy
- Iwakuni Runway Relocation Project, by Vincent R. Donnally
- Internal Erosion & Piping at Fern Ridge Dam, by Jeremy Britton
- Rough River Dam Safety Assurance Project, by Timothy M. O’Leary
- Seepage Collection & Control Systems: The Devil is in the Details , by John W. France
- Dewey Dam Seismic Assessment, by Greg Yankey
- Seismic Stability Evaluation for Ute Dam, New Mexico, by John W. France
- An Overview of Criteria Used by Various Organizations for Assessment and Seismic Remediation of Earth Dams, by Jeffrey S. Dingrando
- A Review of Corps of Engineers Levee Seepage Practices and Proposed Future Changes, by George Sills
- Ground-Penetrating Radar Applications for the Assessment of Pavements, by Lulu Edwards and Don R. Alexander
- Peru Road Upgrade Project, by Michael P. Wielputz
- Slope Stability Evaluation of the Baldhill Dam Right Abutment, by Neil T. Schwanz
- Design and Construction of Anchored Bulkheads with Synthetic Sheet Piles Seabrook, New Hampshire, by Siamac Vaghar and Francis Fung
- Characterization of Soft Claya Case Study at Craney Island, by Aaron L. Zdinak
- Dispersive ClayDispersive Clays – Experience andHistory of the NRCS (Formerly SCS), by Danny McCook
- Post-Tensioning Institute, by Michael McCray
- Demonstration Program Urban Flooding and Channel Restoration in Arid and Semi-Arid Regions (UFDP), by Joan Pope, Jack Davis, Ed Sing, John Warwick, Meg Jonas

Track 6

- State of the Art in Grouting: Dams on Solution Susceptible or Fractured Rock Foundations, by Arthur H. Walz
- Specialty Drilling, Testing, and Grouting Techniques for Remediation of Embankment Dams, by Douglas M. Heenan
- Composite Cut-Offs for Dams, by Dr. Donald A. Bruce and Trent L. Dreese
- State of the Art in Grout Mixes, by James A. Davies
- State of the Art in Computer Monitoring and Analysis of Grouting, by Trent L. Dreese and David B. Wilson
- Quantitatively Engineered Grout Curtains, by David B. Wilson and Trent L. Dreese
- Grout Curtains at Arkabutla Dam: Outlet Monolith Joints and Cracks using Chemical Grout, Arkabutla Lake, MS, by Dale A. Goss
- Chicago Underflow Plan – CUP: McCook Reservoir Test Grout Program, by Joseph A. Kissane
- Clearwater Dam: Sinkhole Repair Foundation Investigation and Grouting Project, by Mark Harris
- Update on the Investigation of the Effects of Boring Sample Size (3” vs 5”) on Measured Cohesion in Soft Clays, by Richard Pinner and Chad M. Rachel
- Soil-Bentonite Cutoff Wall Through Free-Product at Indiana Harbor CDF, by Joe Schulenberg and John Breslin
- Soil-Bentonite Cutoff Wall Through Dense Alluvium with Boulders into Bedrock, McCook Reservoir, by William A. Rochford
- Small Project, Big Stability Problem the Block Church Road Experience, by Jonathan E. Kolber
- Determination of Foundation Rock Properties Beneath Folsom Dam, by Michael K. Sharp, José L. Llopis and Enrique E. Matheu
  Waterbury Dam Mitigation, by Bethany Bearmore
- Armor Stone Durability in the Great Lakes Environment, by Joseph A. Kissane
- Mill Creek - An Urban Flood Control Challenge, by Monica B. Greenwell
- Next Stop, The Twilight Zone, by Troy S. O’Neal
- Limitations in the Back Analysis of Shear Strength from Failures, by Rick Deschamps and Greg Yankey
- Reconstruction of Deteriorated Concrete Lock Walls After Blasting and Other Demolition Removal Techniques, by Stephen G. O'Connor

- Flood Fighting Structures Demonstration and Evaluation Program (FFSD), by George Sills
- Innovative Design Concepts Incorporated into a Landfill Closure and Reuse Design Portsmouth Naval Shipyard, Kittery, Maine, by Dave Ray and Kevin Pavlik
- Laboratory Testing of Flood Fighting Structures, by Johannes L. Wibowo, Donald L. Ward and Perry A. Taylor
- Bluff Stabilization Along Lake Michigan, Using Active and Passive Dewatering Techniques, Allegan Co. Michigan, by Rennie Kaunda, Eileen Glynn, Ron Chase, Alan Kehew and Jim Selegean

Track 7

- Case History: Multiple Axial Statnamic Tests on a Drilled Shaft Embedded in Shale, by Paul J. Axtell, J. Erik Loehr, Daniel L. Jones
- The Sliding Failure of Austin Dam Pennsylvania - Revisited, by Brian H. Greene
- M3 –Modeling, Monitoring and Managing: A Comprehensive Approach to Controlling Ground Movements for Protection of Existing Structures and Facilities, by Francis D. Leathers and Michael P. Walker
- Time-Dependent Reliability Modeling for Use in Major Rehabilitation of Embankment Dams and Foundation, by Robert C. Patev
- Lateral Pile Load Test Results Within a Soft Cohesive Foundation, by Richard J. Varuso
- Engineering Geology Challenge Engineering Geology Challenges During Design and Construction of the Marmet Lock Project, by Ron Adams and Mike Nield
- Mill Creek Deep Tunnel Geologic Conditions and Potential Impacts on Design/Construction, by Kenneth E. Henn III
- McAlpine Lock Replacement Instrumentation: Design, Construction, Monitoring, and Interpretation, by Troy S. O'Neal
- Geosynthetics and Construction of the Second Powerhouse Corner Collector Surface Flow Bypass Project, Bonneville Lock and Dam Project, Oregon and Washington, by Art Fong
- McAlpine Lock Replacement Project Foundation Characteristics and Excavation, by Kenneth E. Henn III
- Structural and Geotechnical Issues Impacting The Dalles Spillwall Construction and Bay 1 Erosion Repair, by Jeffrey M. Ament
  Rock Anchor Design and Construction: The Dalles Dam Spillwalls, by Kristie M. Hartfeil
- The Future of the Discrete Element Method in Infrastructure Analysis, by Raju Kala, Johannes L. Wibowo and John F. Peters
- Sensitive Infrastructure Sites - Sonic Drilling Offers Quality Control and Non-Destructive Advantages to Geotechnical Construction Drilling, by John P. Davis

Track 8

- Evaluation of The Use of LithiuEvaluation of The Use of Lithium Compounds in Controlling ASR in Concrete Pavement, by Mike Kelly
- Roller Compacted Concrete for McAlpine Lock Replacement, by David E. Kiefer
- Soil-Cement for Stream Bank Stabilization, by Wayne Adaska
- Using Cement to Reclaim Asphalt Pavements, by David R. Luhr
- Valley Park 100-Yr Flood Protection Project: Use of 'Engineered Fill' in the Item IV-B Levee Core, by Patrick J. Conroy
- Bluestone Dam: AAR –A Case Study, by Greg Yankey
- USDA Forest Service: Unpaved Road Stabilization with Chlorides, by Michael R. Mitchell
- Use of Ultra-Fine Amorphous Colloidal Silica to Produce a High-Density, High-Strength Grout, by Brian H. Green
- Modular Gabion Systems, by George Ragazzo
- Addressing Cold Regions Issues in Pavement Engineering, by Edel R. Cortez and Lynette Barna
- Geology of New York Harbor: Geological and Geophysical Methods of Characterizing the Stratigraphy for Dredging Contracts, by Ben Baker, Kristen Van Horn and Marty Goff
- Rubblization of Airfield Concrete Pavements, by Eileen M. Vélez-Vega
- US Army Airfield Pavement Assessment Program, by Haley Parsons, Lulu Edwards, Eileen Velez-Vega and Chad Gartrell
- Critical State for Probabilistic Analysis of Levee Underseepage, by Douglas Crum,
- Curing Practices for Modern Concrete Production, by Toy Poole
- AAR at Carters Dam: Different Approaches, by James Sanders
- Concrete Damage at Carters Dam, by Toy Poole
  Damaging Interactions Among Concrete Materials, by Toy Poole
- Economic Effects on Construction of Uncertainty in Test Methods, by Toy Poole
- Trends in Concrete Materials Specifications, by Toy Poole
- Spall and Intermediate-Sized Repairs for PCC Pavements, by Reed Freeman and Travis Mann
- Acceptance Criteria Acceptance Criteria for Unbonded Aggregate Road Surfacing Materials, by Reed Freeman, Toy Poole, Joe Tom and Dale Goss
- Effective Partnering to Overcome an Interruption In the Supply of Portland Cement During Construction at Marmet Lock and Dam, by Billy D. Neeley, Toy S. Poole and Anthony A. Bombich

Track 10

- Marmet Lock &Dam: Automated Instrumentation Assessment, Summer/Fall 2004, by Jeff Rakes and Ron Adams
  Success Dam Seismic Remediation

Track 9

- Fern Ridge Dam, Oregon: Seepage and Piping Concerns (Internal Erosion)

Track 11

- Canton Dam Spillway Stability: Is a Test Anchor Program Necessary?, by Randy Mead
- Dynamic Testing and Numerical Correlation Studies for Folsom Dam, by Ziyad Duron, Enrique E. Matheu, Vincent P. Chiarito, Michael K. Sharp and Rick L. Poeppelman

Status of Portfolio Risk Assessment, by Eric Halpin
- Mississinewa Dam Foundation Rehabilitation, by Jeff Schaefer
- Wolf Creek Dam Seepage Major Rehabilitation Evaluation, by Michael F. Zoccola
- Bluestone Dam DSA Anchor Challenges, by Michael McCray
- Clearwater Dam Major Rehab Project, by Bobby Van Cleave
- Design, Construction and Seepage at Prado Dam, by Douglas E. Chitwood
- Seven Oaks Dam: Outlet Tunnel Invert Damage, by Robert Kwan
- An Overview of An Overview of the Dam Safety ProgramManagement Tools (DSPMT), by Tommy Schmidt

Track 12

- Greenup L&D Miter Gate Repair and Instrumentation, by Joseph Padula, Bruce Barker and Doug Kish
- Marmet Locks and Dam Lock Replacement Project, by Jeffrey S. Maynard,
- Status of HSS Inspections in The Portland District, by Travis Adams
- Kansas City District: Perry Lake Project Gate Repair, by Marvin Parks
- Mel Price – Auxiliary Lock Downstream Miter Gate Repair, by Thomas J. Quigley, Brian K. Kleber and Thomas R. Ruf
- J.T. Myers Lock Improvements Project Infrastructure Conference, by David Schaaf and Greg Werncke
- J.T. Myers Dam Major Rehab, by David Schaaf, Greg Werncke and Randy James
- Greenup L&D, by Rodney Cremeans
- McAlpine Lock Replacement Project, by Kathy Feger
- Roller Compacted Concrete Placement at McAlpine Lock, by Larry Dalton
- Kentucky Lock Addition Downstream Middle Wall Monolith Design, by Scott A. Wheeler
- London Locks and Dam Major Rehabilitation Project, by David P. Sullivan
- Replacing Existing Lock 4: Innovative Designs for Charleroi Lock, by Lisa R. Pierce, Dave A. Stensby and Steve R. Stoltz
- Olmsted L&D, Dam In-the-wet Construction, by Byron McClellan, Dale Berner and Kenneth Burg
- Olmsted Floating Approach Walls, by Terry Sullivan
- John Day Navigation Lock Monolith Repair, by Matthew D. Hanson
- Inner Harbor Navigation Canal (IHNC) Lock Replacement, by Mark Gonski
- Comite River Diversion Project, by Christopher Dunn
- Waterline Support Failure: A Case Study, by Angela DeSoto Duncan
- Public Appeal of Major Civil Projects: The Good, the Bad and the Ugly, by Kevin Holden and Kirk Sunderman
- Chickamauga Lock and Dam Lock Addition Cofferdam Height Optimization Study, by Leon A. Schieber
- Des Moines Riverwalk, by Thomas D. Heinold

Track 13

- Folsom Dam Evaluation of Stilling Basin Performance for Uplift Loading for Historic Flows and Modification of Folsom Dam
- Stilling Basin for Hydrodynamic Loading, by Rick L. Poeppelman, Yunjing (Vicky) Zhang, and Peter J. Hradilek
- Seismic Stress Analysis of Folsom Dam, by Enrique E. Matheu
- Barge Impact Analysis for Rigid Lock Walls ETL 1110-2-563, by John D. Clarkson and Robert C. Patev
- Belleville Locks & Dam Barge Accident on 6 Jan 05, by John Clarkson
- Portugues Dam Project Update, by Alberto Gonzalez, Jim Mangold and Dave Dollar
- Portugues Dam: RCC Materials Investigation, by Jim Hinds
- Nonlinear Incremental Thermal Stress Strain Analysis Portugues Dam, by David Dollar, Ahmed Nisar, Paul Jacob and Charles Logie
- Seismic Isolation of Mission-Critical Infrastructure to Resist Earthquake Ground Shaking or Explosion Effects, by Harold O. Sprague, Andrew Whitaker and Michael Constantino
- Obermeyer Gated Spillway S381, by Michael Rannie
- Design of High Pressure Vertical Steel Gates Chicago Land Underflow Plan McCook Reservoir, by Henry W. Stewart, Hassan Tondravi, Lue Tekola,
- Development of Design Criteria for the Rio Puerto Nuevo Contract 2D/2E Channel Walls, by Janna Tanner, David Shiver, and Daniel Russell
- Indianapolis NortIndianapolis North Phase 3A Warfleigh Section
- Design of Concrete Lined Tunnels in Rock CUP McCook Reservoir Distribution Tunnels Contract, by David Force

Track 14

- GSA Progressive Collapse Design Guidelines Applied to Concrete Moment-Resisting Frame Buildings, by David N. Bilow and Mahmoud E. Kamara,
- UFC 4-023-02 Retrofit of Existing Buildings to Resist Explosive Effects, by Jim Caulder
- Summit Bridge Fatigue Study, by Jim Chu
- Quality Assurance for Seismic Resisting Systems, by John Connor
- Seismic Requirements for Arch, Mech, and Elec. Components, by John Connor
- SBEDS - (Single degree of freedom Blast Effects Design Spreadsheets), by Dale Nebuda,
- Design of Buildings to Resist Progressive Collapse UFC 4-023-03, by Bernie Deneke,
- Fatigue and Fracture Assessment, by Jesse Stuart
- Unified Facilities Criteria: Seismic Design for Buildings, by Jack Hayes
- Evaluation and Repair Of Blast Damaged Reinforced Concrete Beams, by MAJ John L. Hudson
- Building an In-house Bridge Inspection Program
- United Facilities CriteriUnited Facilities Criteria Masonry Design for Buildings, by Tom Wright
- USACE Homeland Security Portal, by Michael Pace
- Databse Tools for Civil Works Projects

- Standard Procedure for Fatigue Evaluation of Bridges, by Phil Sauser
- Consolidation of Structural Criteria for Military Construction, by Steven Sweeney
- Cathodic Protectionfor the South Power Plant Reinforcing Steel, Diego Garcia, BIOT, by Thomas Tehada and Miki Funahashi

Track 15

- Engineering Analysis of Airfield Lighting System Lightning Protection, by Dr. Vladimir A. Rakov and Dr. Martin A. Uman
- Dr. Martin A. Uman
- Charleston AFB Airfield Lighting Vault
- UNIFIED FACILITIES CRITERIA (UFC) UFC 3-530-01 Design: Interior, Exterior Lighting and Controls, by Nancy Clanton and Richard Cofer
- Electronic Keycard Access Locks, by Fred A Crum
- Unified Facilities Criteria (UFC) 3-560-02, Electrical Safety, by John Peltz and Eddie Davis
- Electronic Security SystemElectronic Security Systems Process Overview
- Lightning Protection Standards
- Electrical Military Workshop
- Information Technology Systems Criteria, by Fred Skroban and John Peltz
- Electrical Military Workshop
- Electrical Infrastructure in Iraq- Restore Iraqi Electricity, by Joseph Swiniarski

Track 16

- BACnet® Technology Update, by Dave Schwenk
- The Infrastructur Conference 2005, by Steven M. Carter Sr. and Mitch Duke
- Design Consideration for the Prvention of Mold, by K. Quinn Hart
- COMMISSIONING, by Jim Snyder
- New Building Commissioning , by Gary Bauer
- Ventilation and IAQ TheNew ASHRAE Std 62.1, by Davor Novosel
- Basic Design Considerations for Geothermal Heat Pump Systems, by Gary Phetteplace
- Packaged Central Plants
- Effective Use Of Evaporative Cooling For Industrial And Institutional/Office Facilities, by Leon E. Shapiro
- Seismic Protection For Mechanical Equipment
- Non Hazardous Chemical Treatments for Heating and Cooling Systems, by Vincent F. Hock and Susan A. Drozdz
- Trane Government Systems & Services
- LONWORKS Technology Update, by Dave Schwenk
- Implementation of Lon-Based Specifications by Will White and Chris Newman

Track 17

- Utility System Security and Fort Future, by Vicki Van Blaricum, Tom Bozada, Tim Perkins, and Vince Hock
- Festus/Crystal City Levee and Pump Station
- Chicago Underflow Plan McCook Reservoir (CUP) Construction of Distribution Tunnel and Pumps Installation
- Technological Advances in Lock Control Systems, by Andy Schimpf and Mike Maher
- Corps of Engineers in Iraq Rebuilding Electrical Infrastructure, by Hugh Lowe
- Red River of the North at East Grand Forks, MN & Grand Forks, ND: Flood Control Project – Armada of Pump Stations Protect Both Cities, by Timothy Paulus
- Lessons Learned for Axial/Mixed Flow Propeller Pumps, by Mark A. Robertson
- Creek Automated Gate Considerations, by Mark A. Robertson
- HydroAMP: Hydropower Asset Management, by Lori Rux
- Acoustic Leak Detection for Water Distribution Systems, by Sean Morefield, Vincent F. Hock and John Carlyle
- Remote Operation System, Kaskaskia Dam Design, Certification, & Accreditation, by Shane M. Nieukirk
- Lock Gate Replacement System, by Shaun A. Sipe and Will Smith

Track 20

- “Re-Energizing Medical Facility Excellence”, by COL Rick Bond
- Rebuilding and Renovating The Pentagon , by Brian T. Dziekonski,
- Resident Management System
- Design-Build and Army Military Construction, by Mark Grammer
- Defense Acquisition Workforce Improvements Act - Update, by Mark Grammer
- Construction Management @ Risk: Incentive Price Revision – Successive Targets, by Christine Hendzlik
- Construction Reserve Matrix, by Christine Hendzlik
- Award contingent on several factors..., by Christine Hendzlik
- 52.216-17 Incentive Price Revision--Successive Targets (Oct 1997) - Alt I (Apr 1984), by Christine Hendzlik
- Preconstruction Services, by Christine Hendzlik
- Proposal Evaluation Factors, by Christine Hendzlik
- MILCON Transformation in Support of Army Transformation, by Claude Matsui
- Construction Practices in Russia, by Lance T. Lawton

- Partnering as a Best Practice, by Ray Dupont
- USACE Tsunami Reconstruction for USAID, by Andy Constantaras

Track 21

- Dredging Worldwide, by Don Carmen
- SpecsIntact Editor, by Steven Freitas
- SpecsIntact Explorer, by Steven Freitas
- American River Watershed Project, by Steven Freitas
- Unified Facilities Guide Specifications (UFGS) Conversion To MasterFormat 2004, by Carl Kersten
- Unified Facilities Guide Specifications (UFGS) Status and Direction , by Jim Quinn

Workshops

- Design of Buildings to Resist Progressive Collapse UFC 4-023-03, by Bernie Deneke
- Security Engineering and at Unified Facility Criteria (UFC), by Bernie Deneke, Richard Cofer, John Lynch and Rudy Perkey
- Packaged Central Plants, by Trey Austin

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

2005 Tri-Service Infrastructure Systems Conference & Exhibition

"Re-Energizing Engineering Excellence"

ON-SITE AGENDA

The America's Center
St. Louis Convention Center
St. Louis, MO
August 2-4, 2005
Event # 5150

Tri-Service Infrastructure Systems Conference & Exposition 2005

2005 Tri-Service Infrastructure Systems Conference & Exhibition

AGENDA

Monday, August 1, 2005

8:00 AM-9:00 PM	Exhibit Move-In
12 Noon-5:00 PM	Registration

Tuesday, August 2, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-8:15 AM Ferrara Theatre	Welcome and Introduction
8:15 AM-9:00 AM Ferrara Theatre	The Future of Engineering and Construction Panel Moderator: *Mr. Don Basham, Chief, Engineering & Construction, USACE* Panelists: *LTG Carl A. Strock, Commander, USACE* *Dr. James Wright, Chief Engineer NAVFAC*
9:00 AM-9:45 AM Ferrara Theater	Keynote Address The Lord of the Things: The Future of Infrastructure Technologies *Mr. Paul Doherty, AIA, Managing Director,* *General Land Corporation*
9:45 AM-10:15 AM	Break
10:15 AM-11:15 AM Ferrara Theatre	USACE Engineering and Construction Panel Moderator: *Mr. Don Basham, Chief, Engineering & Construction, USACE* Panelists: *MG Donald T. Riley, Director, Civil Works, USACE* *BG Bo M. Temple, Director, Military Programs, USACE* *Dr. Michael J. O'Connor, Director, R&D*
10:15 AM-11:15 AM Room 225	Navy General Session
11:00 AM - 7:00 PM	Exhibits Open
11:15 AM-1:00 PM	Lunch in Exhibit Hall (on your own)
11:15 AM-1:00 PM Washington G	Women's Career Lunch Session (Bring your lunch from Exhibit Hall) Moderator: *Ms. Demi Syriopoulou, HQ USACE* Opening Remarks: *LTG Carl A. Strock, Commander, USACE* Presentations & Discussion: *Dwight Beranek, Kristine Allaman, Donald Basham, HQ USACE*
1:00 PM-1:55 PM Ferrara Theatre	Introduction to Multi-Disciplinary Tracks

Tuesday, August 2, 2005

2:00 PM-2:50 PM — 1st Round of Multi-Disciplinary Concurrent Sessions (Continued)

Track 1: Acquisition Strategies for Civil Works
Room 230
Walt Norko

Track 2: Risk and Reliability Engineering
Room 231
Anjana Chudgar
David Schaaf

Track 3: Portfolio Risk Assessment
Room 232
Eric Halpin

Track 4: Hydrology, Hydraulics and Coastal Engineering Support for USACE
Room 240
Jerry Webb
Darryl Davis

Track 5: Civil Works R&D Forum
Room 241
Joan Pope

Track 6: Civil Works Security Engineering
Room 242
Joe Hartman
Bryan Cisar

Track 7: Building Information Model Applications
Room 226
Brian Huston
Daniel Hawk

Track 8: Design Build for Military Projects
Room 220
Mark Grammer

Track 9: Army Transformation/Global Posture Initiative/ Force Modernization
Room 221
Al Young
Claude Matsui

Track 10: Force Protection - Army Access Control Points
Room 222
John Trout

Track 11: Cost Engineering Forum on Government Estimates vs. Actual Costs
Room 227
Ray Lynn *Jack Shelton* *Kim Callan*
Miguel Jumilla *Ami Ghosh* *Joe Bonaparte*

Track 12: Engineering & Construction Information Technology
Room 228
MK Miles

Track 13: Sustainable Design
Room 223
Harry Goradia

Track 14: ACASS/CCASS/CPARS
Room 224
Ed Marceau
Marilyn Nedell

Track 15: Whole Building Design Guide
Room 229
Earle Kennett

Tuesday, August 2, 2005

2:50 PM-3:30 PM	Break in Exhibit Hall
3:30 PM-4:20 PM	2nd Round of Multi-Disciplinary Sessions
4:30 PM-5:20 PM	3rd Round of Multi-Disciplinary Sessions
5:30 PM-7:00 PM	Ice Breaker Reception in Exhibit Hall

Wednesday, August 3, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-9:30 AM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
9:00 AM	Exhibit Hall Opens
9:30 AM-10:30 AM	Break in Exhibit Hall
10:30 AM-12:00 Noon	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
12:00 Noon-1:30 PM	Lunch in Exhibit Hall
1:30 PM-3:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on the Following Pages)
3:00 PM-4:00 PM	Break in Exhibit Hall
4:00 PM-5:30 PM	Concurrent Sessions
5:00 PM	Exhibit Hall Closes

Thursday, August 4, 2005

7:00 AM-8:00 AM	Registration and Continental Breakfast
8:00 AM-9:30 AM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
9:30 AM-10:30 AM	Break in Exhibit Hall (Last Chance to view Exhibits)
10:30 AM-12:00 Noon	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
12:00 Noon-1:30 PM	Lunch (On your own)
12:00 Noon-6:00 PM	Exhibits Move-Out
1:30 PM-3:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on Following Pages)
3:00 PM-3:30 PM	Break
3:30 PM-5:00 PM	Concurrent Sessions (Please Refer to Concurrent Session Schedule on following pages)

Wednesday, August 3, 2005 Concurrent Sessions

HH&C Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	10:30 AM	11:00 AM	11:30 AM
Room 220	**TRACK 1** Coastal Structures Session 1A	Protecting the NJ Coast using large stone seawalls *Cameron Chasten*	Chicago shoreline storm damage reduction project *Andrew Bezinger*	Risk and reliability in coastal structure design *Jeffrey Melby*	Break in Exhibit Hall	**TRACK 1** Coastal Regional Manangement Session 1B	Cascade: An integrated regional model for decision support *Nicholas Kraus*	Upper Texas coast sediment transport modeling & sediment budgets *David King*	Sediment compatibility for beach nourishment in North Carolina *Gregory Williams*
Room 221	**TRACK 2** Ecological Engineering & Design Session 2A	Ecological and engineering considerations for dam decommissioning, retrofits and operations *Jock Conyngham*	Hydraulic design of tidegates and other water control structures for ecosystem restoration on the Columbia Estuary *Patrick O'Brien*	Innovative Integration of engineering and biological tools aids hydraulic structure design for restoring T&E fish *Andrew Goodwin*	Break in Exhibit Hall	**TRACK 2** Ecological Engineering & Design Session 2B	Innovative hydraulic structure design at Lower Granite Dam: design that saves water and salmon *Lynn Reese*	Impacts of using a spillway for juvenile fish passage on typical design criteria *Robert Buchholz*	Hydraulic design of juvenile fish passage facility for reservoir with wide range of pool elevation - Hanson Dam *Dennis Mekkers*
Room 222	**TRACK 3** Modeling Session 3A	Corps involvement in the FEMA map modernization program *Kete White*	Innovative approximate study method for FEMA map modernization program *John Hunter*	Flood fight structures demonstration evaluation program *Fred Pinkard*	Break in Exhibit Hall	**TRACK 3** Modeling Session 3B	Integrating climate dynamics into water resources planning and management *Kate White*	Risk and uncertainty in flood damage reduction studies *Rob Moyer*	Uncertainty analysis and stochastic simulation *Jacke Hallberg*
Room 223	**TRACK 4** H&H Aspects of Dam Safety Session4A	Hydrologic aspects of operating in failure mode: Fern Lake *Bruce Duffe*	Dam safety study with cascading failures *Gordon Lance*	Rough river spillway capacity *Richard Pruitt*	Break in Exhibit Hall	**TRACK 4** International/ Military H&H Session 4B	Capability restoration and historic marsh restoration *Fauwaz Hanbali*	USACE capacity building effort for Iraq MoWR *Steven Wilhelms*	USACE support of CMEP in 2004 *Mark Jensen*

12 Noon — **Lunch in Exhibit Hall**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	4:00 PM	4:30 PM	5:00 PM
Room 220	**TRACK 1** Coastal Sediments Session 1C	Evaluating beachfill project performance in the NAP *Monica Chasten*	USACE's regional coastal mapping program *Jennifer Wozencraft*	US Naval Academy flood damage reduction project using structural and non-structural measures *Stacey Underwood*	Break in Exhibit Hall	**TRACK 1** Shore Protection Projects Session 1D	Hurricane Isabel effects on communities *Jane Jablonski*	Repair of the shore protection projects adversly affected by the hurricanes of 2004 *Rick McMillen*	Shore protection project performance assessmet *Sharon Haggett*
Room 221	**TRACK 2** Modeling Ecological Restoration/Systems Assessment Session 2C	Regional modeling requirements for ecosystem restoration *Maged Hussein*	Tools for wetlands permit evaluation: Modeling groundwater and surface water distribution systems *Cary Talbot*	Current research in fate and transport of chemical and biological contaminants in water distribution systems *Mark Ginsberg*	Break in Exhibit Hall	**TRACK 2** Ecosystem Habitat Restoration Session 2D	Aquatic habitat restoration in the lower Missouri River *Chance Bittner*	Missouri River restoration: shallow water habitat creation *Daniel Pridal*	Ecosystem restoration for fish and wildlife habitat on the upper Mississippi River *Jon Hendrickson*
Room 222	**TRACK 3** River Morphology Session 3C	Geomorphology study of the Mississippi river *Edward Braurer*	Bank erosion and morphology of the Kaskaskia river *Michael Rodgers*	Sediment movement at Kansas City from water years 1920 to 2004 *Alan Tool*	Break in Exhibit Hall	**TRACK 3** Modeling River Sedimentation Session 3D	Sediment impact assessment model (SIAM) *David Biedenharn*	Sediment modeling of MS River, Cairo to Gulf *Basil Arthur*	Sediment modeling of rivers *Charlie Berger*
Room 223	**TRACK 4** GIS and Surveying Session 4C	GIS tools available now to support HHC *Timothy Pangburn*	High resolution bathymetry and fly-through visualization *Paul Clouse*	GIS & surveying to support national FEMA *Mark Flick*	Break in Exhibit Hall	**TRACK 4** GIS and Surveying Session 4D	Update flood emergency plans with GIS and HEC-RAS *Stephen Stello*	High resolution visualizations of multibeam data: lower Mississippi River *Thomas Tobin*	GIS in SWWRP *Andrew Bruzewicz*

Wednesday, August 3, 2005 Concurrent Sessions

Geotechnical Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	10:30 AM	11:00 AM	11:30 AM
Room 226	TRACK 5 Session 5A	Levee lowering for the Lewis & Clark bi-centennial celebration *Robert Berger*	Conduits through embankment dams - best practices for design, construction, problem id and evaluation, inspection, maintenance, renovation & repair *Dave Pezza*	Design, construction and seepage at Prado Dam, CA *Douglas Chitwood*	Break in Exhibit Hall	TRACK 5 Session 5B	2-D liquefaction evaluation with q4MESH *David Serafini*	Unlined spillway erosion risk assessment *Johannes Wibowo*	Seismic remediation of the Clemson upper and lower diversion dams: evaluation, conceptal design and design (P1) *Ben Foreman*
Room 227	TRACK 6 Session 6A	USACE dams on solution susceptible or highly fractured rock foundations *Art Walz*	Special drilling and grouting techniques for remedial work in embankment dams *Doug Heenan*	Composite grouting & cutoff wall solutions *Donald Bruce*	Break in Exhibit Hall	TRACK 6 Session 6B	State of the art in grout mixes *James Davies*	State of the art in computer monitoring, control, and analysis of grouting *Trent Dreese*	Quantitatively engineered grout courtains *David Wilson*
Room 228	TRACK 7 Session 7A	Case history: multiple axial statnamic test on a drilled shaft embedded in shale *Paul Axtell*	Austin Dam, Pennsylvania: the sliding failure of a concrete gravity dam revisited *Brian Greene*	M^3 (Modeling, Monitoring and Manufacturing) - a comprehensive approach to controlling ground movements for protecting existing structures and facilities *Michael Walker*	Break in Exhibit Hall	TRACK 7 Session 7B	Controlled modulus columns: A ground improvement technique *Martin Taube*	Time-dependent reliability models for use in major rehabilitation of embankment dams and foundations *Robert Patev*	Engineering geology design challenges at the Soo Lock replacement project *Mike Nield*
Room 229	TRACK 8 Session 8A	Evaluation of the use of lithium nitrate in controlling alkali-silica reactivity in an existing concrete pavement *Mike Kelly*	Use of self-consolidating concrete in the installation of bulhead slots - Lessons learned in the use of this innovative concrete material *Darrell Morey*	Roller compacted concrete for McAlpine lock walls *David Kiefer*	Break in Exhibit Hall	TRACK 8 Session 8B	Soil-cement for stream bank stabilization *Wayne Adaska*	Using cement to reclaim asphalt pavements *David Luhr*	Valley park 100-year flood protection project: use of "engineered fill" in item 4b levee core *Patrick Conroy*

12 Noon — **Lunch in Exhibit Hall**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	4:00 PM	4:30 PM	5:00 PM
Room 226	TRACK 5 Session 5C	Seismic remediation of the Clemson upper and lower diversion dams: deep soil mix construction *Ben Foreman*	Historical changes in the state-of-the-art of seismic engineering & effects of those changes on the seismic response studies of large embankement dams *Samuel Stacy*	New Iwakuni runway *Vincent Donnally*	Break in Exhibit Hall	TRACK 5 Session 5D	Internal erosion and piping at Fern Ridge dam: Problems and solutions *Jeremy Britton, Ph.D.*	Rough river dam safety assurance project *Timothy O'Leary*	Seepage collection and control systems: The devil is in the details *John France*
Room 227	TRACK 6 Session 6C	Grout courtains at Arkabutla Dam outlet monolith joints using chemical grout to seal joints, Arkabutla, MS *Dale Goss*	Results from a large-scale grout test program, Chicago underflow plan (CUP) McCook Reservoir *Joseph Kissane*	Clearwater Dam - foundation drilling and grouting for repair of sinkholes *Mark Harris*	Break in Exhibit Hall	TRACK 6 Session 6D	Update on the investigation of the effects of boring sample size (3' vs 5") on measured cohesion in soft clays *Richard Pinner*	Soil-bentonite cutoff wall through free-product at Indiana Harbor CDF *Joseph Schulenberg*	Soil-bentonite cutoff wall through dense alluvium with boulders into bedrock, McCook Reservoir *William Rochford*
Room 228	TRACK 7 Session 7C	Engineering geology during design and construction of the Marmet lock project *Michael Nield*	Mill Creek deep tunnel - Geological affects on proposed structures and construction techniques *Tres Henn*	Earth pressure loads behind the new McAlpine Lock replacement project *Troy O'Neal*	Break in Exhibit Hall	TRACK 7 Session 7D	Geosynthetics and construction of the Bonneville lock and dam second powerhouse corner collector surface flow bypass project *Art Fong*	McAlpine lock replacement - foundation characteristics and excavation *Kenneth Henn*	
Room 229	TRACK 8 Session 8C	What to do if your dam is expanding: a case study *Greg Yankey*	Unpaved road stabilization with chlorides *Michael Mitchell*	Use of ultra-fine amorphous colloidal silica to produce a high-density, high-strength rock-matching grout for instrumentation grouting *Brian Green*	Break in Exhibit Hall	TRACK 8 Session 8D	Innovative techniques in the Gabion system *George Ragazzo*	Addressing cold regions issues in pavement engineering *Lynette Barna*	Geology of New York Harbor - geological and geophysical methods of characterizing the stratigraphy for dredging contracts *Ben Baker*

Wednesday, August 3, 2005 Concurrent Sessions

Structural Engineering Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	10:30 AM	11:00 AM	11:30 AM
Room 240	**TRACK 12** Civil Works Structural — Session 12A	Recent changes to Corps guidance on steel hydraulic structures — *Joe Padula*	Crack repairs and instrumentation of Greenup L&D miter gate — *Doug Kish*	Recent hydraulic steel structures findings in the Portland district — *Travis Adams*	Break in Exhibit Hall	**TRACK 12** Civil Works Structural — Session 12B	Perry Lake gate repair — *Marvin Parks*	Mel Price auxiliary lock gate repair — *Andrew Schimpf*	Mel Price auxiliary lock gate repair (Continued) — *Andrew Schimpf*
Room 241	**TRACK 13** Civil Works Structural — Session 13A	Folsom Dam evaluation of stilling basin performance for uplift loading for historic flows — *Rick Poeppelman*	Rehabilitation of Folsom Dam stilling basin — *Rick Poeppelman*	Seismic stability evaluation of Folson Dam — *Enrique Matheu*	Break in Exhibit Hall	**TRACK 13** Civil Works Structural — Session 13B	Seismic stress analysis of Folsom Dam — *Enrique Matheu*	Barge impact guidance for rigid lock walls, ETL 110-2-563 and probalistic barge impact analysis — *John Clarkson*	Belleville barge accident — *John Clarkson*
Room 242	**TRACK 14** Bridges/ Buildings — Session 14A	The USACE bridge management system — *Phil Sauser*	Standard procedures for fatigue evaluation of bridges — *Phil Sauser*	Fatigue and fracture assessment of Jesse Stuart Highway Bridge — *John Jaeger*	Break in Exhibit Hall	**TRACK 14** Bridges/ Buildings — Session 14B	Building an in-house bridge inspection program — *Jennifer Laning*	Fatigue analysis of Summit bridge — *Jim Chu*	Consolidation of Structural criteria for military construction — *Steve Sweeney*

12 Noon — **Lunch in Exhibit Hall**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	4:00 PM	4:30 PM	5:00 PM
Room 240	**TRACK 12** Civil Works Structural — Session 12C	Overview of John T. Myers locks improvements project — *Greg Werncke*	John T. Myers rehabilitation study — *Greg Werncke*	Ohio River Greenup Lock extension — *Rodney Cremeans*	Break in Exhibit Hall	**TRACK 12** Civil Works Structural — Session 12D	McAlpine lock replacement project, project summary and status of construction — *Kathleen Feger*	Results of Roller Compacted concrete placement at the McAlpine lock replacement project — *Larry Dalton*	Tennessee Valley authority Kentucky lock addition downstream middle wall monoliths — *Scott Wheeler*
Room 241	**TRACK 13** Civil Works Structural — Session 13C	Portugues Dam, Ponce, Puerto Rico project update — *Jim Mangold*	Portugues Dam, Ponce, Puerto Rico, RCC design and testing program — *Jim Hinds*	Portugues Dam, Ponce, Puerto Rico, Thermal analysis of hydration and subsequent cooling of RCC — *Ahmed Nisar*	Break in Exhibit Hall	**TRACK 13** Civil Works Structural — Session 13D	Miter gate anchorage design — *Andy Harkness*	Obermeyer gated spillway project - S381 — *Michael Rannie*	McCook Reservoir design of high pressure steel gates — *Luelseged Tekola*
Room 242	**TRACK 14** Brigdes/ Buildings — Session 14C	Unified facilities criteria seismic design for buildings — *Jack Hayes*	Seismic requirements for architectural, mechanical and electrical components — *John Connor*	Quality assurance for seismic resisting systems — *John Connor*	Break in Exhibit Hall	**TRACK 14** Bridges/ Buildings — Session 14D	Unified facilities criteria masonry structural design for buildings — *Tom Wright*	Cathodic protection of building reinforcing steel (in Diego Garcia) — *Thomas Tehada*	USACE Homeland security web portal — *Mike Pace*

Wednesday, August 3, 2005 Concurrent Sessions

Dam Safety Track & Construction Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	10:30 AM	11:00 AM	11:30 AM
Room 224	**TRACK 10** Dam Safety, Session 10A	Tuttle Creek warning and alert systems *Bill Empson*	Lessons from the dam failure warning system exercise - Tuttle Creek *Bill Empson*	Tuttle Creek ground modification treatability program *Bill Empson*	Break in Exhibit Hall	**TRACK 10** Dam Safety, Session 10B	Dam safety analysis of Cannelton Dam *Terry Sullivan*	John Martin Dam, CO - Dam safety structural upgrades *George Diewald*	Vesuvius Lake Dam rehabilitation *Susan Peterson*
Room 225	**TRACK 11** Dam Safety, Session 11A	Canton lake spillway stabilization project: IS a test anchor program NECESSARY? *Randy Mead*	Dynamic testing and numerical correlation studies for Folsom dam *Ziyad Duron*	Status of portfolio risk assessment *Eric Halpin*	Break in Exhibit Hall	**TRACK 11** Dam Safety, Session 11B	Mississinewa Dam remediation *Jeff Schaefer*	Wolf creek seepage history *Michael Zoccola*	Blue dam major rehabilitation *Michael McCray*
Room 230	**TRACK 19** Construction, Session 19A	RMS Update *Haskell Barker*	RMS Update (Continued) *Haskell Barker*	Updated CQM for Contractors Course *Walt Norko*	Break in Exhibit Hall	**TRACK 19** Construction, Session 19B	Lessons learned on major construction projects *Jim Cox*	Update on safety issues - Safety manual 385-1-1 *Charles Ray Waits*	Update on safety issues - safety manual 385-1-1 (continued) *Charles Ray Waits*
Room 231	**TRACK 20** Construction, Session 20A	Construction methods in Russia *Lance Lawton*	Construction methods in Russia (Continued) *Lance Lawton*	Renovating the Pentagon using Design/Build delivery *Brian Dziekonski*	Break in Exhibit Hall	**TRACK 20** Construction, Session 20B	Completion of the Olmsted approach walls *Dale Miller*	Completion of the Olmsted approach walls (Continued) *Dale Miller*	Construction management at risk *Christopher Prinslow*

12 Noon — **Lunch in Exhibit Hall**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	4:00 PM	4:30 PM	5:00 PM
Room 224	**TRACK 10** Dam Safety, Session 10C	Project specific risk analysis - Success Dam *Ronn Ross*	Dam safety lessons learned, Winter storm 2005, Muskingum & Scioto Basins *Charles Barry*	Dam security and Dams Government Coordinating Council *Roy Braden*	Break in Exhibit Hall	**TRACK 10** Dam Safety, Session 10D	Prompton Dam hydrologic deficiency and spillway modification *Troy Cosgrove*	"Well, that's water over the dam" - Rough River spillway adequacy design *Richard Pruitt*	Roller-compacted concrete for dam spillways and overtopping protection *Fares Abdo*
Room 225	**TRACK 11** Dam Safety, Session 11C	Clearwater Dam major rehabilitation *Bobby Van Cleave*	Success dam seismic dam safety modification *Norbert Suter*	Problems on the Santa Ana River - Prado Dam *Douglas Chitwood*	Break in Exhibit Hall	**TRACK 11** Dam Safety, Session 11D	Problems on the Santa Ana River - Seven Oaks Dam *Robert Kwan*	Dam safety program management tools *Tommy Schmidt*	
Room 230	**TRACK 19** Construction, Session 19C	3D Modeling and impact on constructability *Gary Cough*	3D Modeling and impact on constructability (Continued) *Gary Cough*	Construction in Iraq & Afganistan *Walt Norko*	Break in Exhibit Hall	**TRACK 19** Construction, Session 19D	Air Force streamlining Design/Build *Joel Hoffman*	Air Force streamlining Design/Build (Continued) *Joel Hoffman*	Sustainable design requirements & construction implementation *Harry Goradia*
Room 231	**TRACK 20** Construction, Session 20C	Tsunami reconstruction *Andy Constantaras*	Tsunami reconstruction (Continued) *Andy Constantaras*	Military construction transformation in support of Army transformation *Sally Parsons*	Break in Exhibit Hall	**TRACK 20** Construction, Session 20D	MEDCOM Construction Issues *Rick Bond*	MEDCOM Construction Issues (Continued) *Rick Bond*	*TBA*

Wednesday, August 3, 2005 Concurrent Sessions

Electrical & Mechanical Engineering Track

Room	Track	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track	10:30 AM	11:00 AM	11:30 AM
Room A	**TRACK 15** Military Electrical — **Session 15A**	Tri-Service Electrical Criteria Overview - *Tri-Service Panel*	Tri-Service Electrical Criteria Overview - (Continued) *Tri-Service Panel*	Tri-Service Electrical Criteria Overview -(Continued) *Tri-Service Panel*	Break in Exhibit Hall	**TRACK 15** Military Electrical — **Session 15B**	Interior/Exterior and security lighting criteria *Tri-Service Panel*	Information technology systems criteria *Tri-Service Panel*	Information technology systems criteria (Continued) *Tri-Service Panel*
Room B	**TRACK 16** Military Mechanical — **Session 16A**	Building Commissioning *Dale Herron*	HVAC Commissioning *Dale Herron*	Ventilation and indoor air quality *Davor Novosel*	Break in Exhibit Hall	**TRACK 16** Military Mechanical — **Session 16B**	Ventilation and indoor air quality (Continued) *Davor Novosel*	Refrigerant implications for HVAC specifications, selection, and o&m - now and future *Mike Thompson*	Refrigerant implications for HVAC specifications, selection, and o&m - now and future (Continued) *Mike Thompson*
Room D	**TRACK 17** Military Mechanical / Electrical — **Session 17A**	Sustainable design update *Harry Goradia*			Break in Exhibit Hall	**TRACK 17** Military Mechanical / Electrical — **Session 17B**	Utility systems security and fort future *Vicki L. Van Blaricum*	Acoustic leak detection for utilities distribution systems *Sean Morefield*	Acoustic leak detection for utilities distribution systems (Continued) *Sean Morefield*
Room E	**TRACK 18** Civil Mechanical — **Session 18A**	Emsworth Dam vertical lift gate hoist replacement *John Nites*	Hydraulic drive for Braddock Dam *Janine Krempa*	John Day navigation lock upstream lift gate wire rope failure *Ronald Wridge*	Break in Exhibit Hall	**TRACK 18** Civil Mechanical — **Session 18B**	Overhead bulkhead at Olmstead Lock *Rick Schultz*	Replacement of gate # 5 intermediate gear and pinion at RC Byrd Lock and Dam *Brenden McKinley*	Mechanical design issues during construction of McAlpine Lock *Richard Nichols*

12 Noon — **Lunch in Exhibit Hall**

Room	Track	2:00 PM	2:30 PM	3:00 PM	3:30 PM	Track	4:00 PM	4:30 PM	5:00 PM
Room A	**TRACK 15** Military Electrical — **Session 15C**	Mass notification system *Tri-Service Panel*	Mass notification system (Continued) *Tri-Service Panel*	Electronic card access locks *Fred Crum*	Break in Exhibit Hall	**TRACK 15** Military Electrical — **Session 15D**	Lightning protection standards *Richard Bouchard*	Lightning and surge protection *Tri-Service Panel*	Lightning and surge protection (Continued) *Tri-Service Panel*
Room B	**TRACK 16** Military Mechanical — **Session 16C**	Basic design considerations for geothermal heat pump systems *Gary Phetteplace*	Basic design considerations for geothermal heat pump systems (Continued) *Gary Phetteplace*	Pentagon renovation *Mitch Duke*	Break in Exhibit Hall	**TRACK 16** Military Electrical — **Session 16D**	Effective use of evaporative cooling for industrial and institutional/office facilities *Leon Shapiro*	Efective use of evaporative cooling for industrial and institutional/office facilities (Continued) *Leon Shapiro*	Non-hazardous chemical treatments for heating and cooling systems *Vincent Hock*
Room D	**TRACK 17** Civil Mechanical / Electrical — **Session 17C**	Hydropower asset management partnership (hydroAMP) *Lori Rux*	New gas fueled/diesel fueled turbine powered electrical generating station in Iraq *Lester Lowe*	The construction of distribution tunnels and pump installation for the metropolitan Chicago sewer systems *Ernesto Go*	Break in Exhibit Hall	**TRACK 17** Civil Mechanical / Electrical — **Session 17D**	The Festus/Crystal City levee and pump station project *Stephen Farkas*	Remote operations for Kaskaskia Dam *Shane Nieukirk*	Technological advances in lock control systems *Andy Schimpf*
Room E	**TRACK 18** Civil Mechanical — **Session 18C**	New coating products for civil works structures *Al Beitelman*	New guide specification for procurement of turbine oils *John Micetic*	Synchronous condensing with large Kaplan turbine - A case study *Brian Moentenich*	Break in Exhibit Hall	**TRACK 18** Civil Mechanical — **Session 18D**	Acquifer storage and recovery (ASR) system *Gerald Deloach*	Wastewater infrastructure improvements in Appalachia *James Sadler*	Storm water pumps *Thomas Jamieson*

Thursday, August 4, 2005 Concurrent Sessions

HH&C Track

Room	Track	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track	10:30 AM	11:00 AM	11:30 AM
Room 220	TRACK 1 Sedimentation & New Concepts Session 1E	Ice jams, contaminated sediment and structures Clark Fork River, MT *Andrew Tuthill*	Increased bed erosion due to ice *John Hains*	Monitoring the Mississippi River using GPS coordinated video *James Gutshall*	Break in Exhibit Hall	TRACK 1 Sedimentation, Case Examples Session 1F	Watershed approach to stream stability the reduction of nutrients *John B. Smith*	Monitoring the effects of sedimentation from Mount St. Helen *Alan Donner*	Navigation and environmental interests in alleviating repetitive dredging *Jason Brown*
Room 221	TRACK 2 Water Management Session 2E	Enhancements and new capabilities of HEC-ResSim 3.0 *Fauwaz Hanbali*	Transition to Oracle based data system *Joel Asunskis*	Accessing real time Mississippi Valley water level data *Rich Engstrom*	Break in Exhibit Hall	TRACK 2 Water Management Session 2F	Hurricane Season 2004 *Susan Sylvester*	Reevaluation of a project's flood control benefits *Ferris Chamberlin*	Helmand Valley water management plan *Jason Needham*
Room 222	TRACK 3 Case Studies Session 2E	Red River of the north flood protection project *Michael Lesher*	Southeast Arkansas flood control & water supply feasibility study *Thomas Brown*	McCook and Thorton tunnel and reservoir modeling *David Kiel*	Break in Exhibit Hall	TRACK 3 Case Studies Session 3F	Ala Wai Canal Project, Honolulu, Oahu, Hawaii *Lynnette Schapers*	Missouri River geospatial decision support framework *Brian Baker*	Systemic analysis of the Mississippi & Illinois Rivers *Dennis Stephens*
Room 223	TRACK 4 Modeling Session 4E	Hydrologic models supported by ERDC *Robert Wallace*	HEC-HMS Version 3.0 new features *Jeff Harris*	SEEP2D & GMS: Simple tools for solving a variety of seepage problems *Clarissa Hansen*	Break in Exhibit Hall	TRACK 4 Modeling Session 4F	Water quality and sediment transport in HEC-RAS *Mark Jensen*	Advances to the GSSHA program *Aaron Byrd*	Software integration for watershed studies HEC-WAT *Chris Dunn*

12 Noon **Lunch**

Room	Track	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track	3:30 PM	4:00 PM	4:30 PM
Room 220	TRACK 1 Water Quality Management Session 1G	San Francisco Bay Mercury TMDL-Implications for constructed wetlands *Herb Fredrickson*	Abandoned mine land: Eastern and Western perspectives *Kate White*	A lake tap for temperature control tower construction at Cougar Dam *Steve Schlenker*	Break	TRACK 1 Watershed Management Session 1H	Demonstrating innovative river restoration technologies: Truckee River, NV *Chris Dunn*	Comprehensive watershed restoration in the Buffalo district *Anthony Friona*	Translating the hydrologic tower of Babel *Dan Crawford*
Room 221	TRACK 2 Water Management Session 2G	Developing reservoir operation plans to manage erosion *Patrick O'Brien*	New approaches to water management decision making *James Barton*	Improved water supply forecasts for Kooteny basin using principal components regression *Randal Wortman*	Break	TRACK 2 Water Management Session 2H	Prescriptive reservoir modeling and ROPE study *Jason Needham*	Missouri River mainstem operations *Larry Murphy*	Res-Sim model for the Columbia River *Arun Mylvahanan*
Room 222	TRACK 3 Section 227 Session 3G	Section 227 Workshop/ Program Review *William Curtis*	Section 227 Workshop/ Program Review (Continued) *William Curtis*	Section 227 Workshop/ Program Review (Continued) *William Curtis*	Break	TRACK 3 Section 227 Session 3H	Section 227 Workshop/ Program Review *William Curtis*	Section 227 Workshop/ Program Review (Continued) *William Curtis*	Section 227 Workshop/ Program Review (Continued) *William Curtis*
Room 223	TRACK 4 Modeling Session 4G	Little Calumet River unsteady flow model conversion *Rick Ackerson*	Kansas City River basin model *Edward Parker*	Design guidance for breakup ice control *Andrew Tuthill*	Break	TRACK 4 Modeling Session 4H	Forebay flow simulations using Navier-Stokes code *Charlie Berger*	Use of regularizatino as a method for watershed model calibration *Brian Skahill*	Demonstration program in the arid southwest *Margaret Jonas*

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 226	TRACK 5 / Session 5E (8:00–9:00); Session 5F (10:30–11:30)	Dynamic deformation analyses Dewey Dam Huntintong District Corps of Engineers *Greg Yankey*	Seismic stability evaluation for Ute Dam, NM *John France*	An overview of criteria used by various organizations for assessments and seismic remediation of earth dams *Sean Carter*	Break in Exhibit Hall	USACE seepage berm design criteria and district practices *George Sills*	Ground penetrating radar applications for the assessment of airfield pavements *Lulu Edwards*	Challenges of the Fernando Belaunde Terry road upgrade Campanillia to Pizana - Peru road project *Michael Wielputz*
Room 227	TRACK 6 / Session 6E (8:00–9:00); Session 6F (10:30–11:30)	Small geotechnical project, big stability problem - The Block Church Road experience *Jonathan Kolber*	Geophysical investigation of foundation conditions beneath Folsom Dam *Jose Llopis*	Bioengineering slope stabilization techniques coupled with traditional engineering applications - The result a stable slope *Bethany Bearmore*	Break in Exhibit Hall	Shoreline armor stone quality issues *Joseph Kissane*	Mill Creek - An urban flood control challenge *Monica Greenwell*	Next stop, The Twilight Zone *Troy O'Neal*
Room 228	TRACK 7 / Session 7E (8:00–9:00); Session 7F (10:30–11:30)	The geotechnical and structural issues impacting the Dalles spillway construction *Kristie Hartfeil*	The Dalles spillway engineering and design *Kristie Hartfeil*	The future of the discrete element method in infrastructure analysis *Raju Kala*	Break in Exhibit Hall	Evaluating the portable falling weight deflectometer as a low-cost technique for posting seasonal load restrictions on low volume payments *Maureen Kestler*	Soil structure interaction effects in the seismic evaluation of success dam control tower *Michael Sharp*	Olmsted locks and Dam project geotechnical/construction issues *Jeff Schaefer*
Room 229	TRACK 8 / Session 8E (8:00–9:00); Session 8F (10:30–11:30)	Rubblization of airfield concrete pavement *Eileen Velez-Vega*	US Army airfield pavement assessment program *Haley Parsons*	Critical state for probabilistic analysis of levee underseepage *Douglas Crum*	Break in Exhibit Hall	Curing practices for modern concrete construction *Toy Poole*	AAR at Carters Dam, a different approach *James Sanders*	Concrete damage at Carters Dam, GA *Toy Poole*

12 Noon **Lunch**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 226	TRACK 5 / Session 5G (1:30–2:30); Session 5H (3:30–4:30)	Slope stability evaluation of the Baldhill Dam right abutment *Neil Schwanz*	Lateral pile load test results within a soft cohesive foundation *Richard Varuso*	Design and construction of anchored bulheads for river diversion, Seabrook, NH *Siamac Vaghar*	Break	Characterization of soft marine clays - A case study at Craney Island *Aaron Zdinak*	50 years of NRSC experience with engineering problems caused by dispersive clays *Danny McCook*	Changes in the post-tensioning institutes new (4th Ed. 2004) "Recommendations for prestressed rock and soil anchors" *Michael McCray*
Room 227	TRACK 6 / Session 6G (1:30–2:30); Session 6H (3:30–4:30)	Perils in back analysis failures *Greg Yankey*	Reconstruction of deteriorated lock walls concrete after blasting and other demolition removal techniques *Steve O'Connor*	Flood fighting structures demonstrations and evaluation program *George Sills*	Break	Innovative design concepts incorporated into a landfill closure and reuse design *Dave Ray*	Laboratory testing of flood fighting structures *Johannes Wibowo*	Bluff stabilization along Lake Michigan using active and passive dewatering techniques *Eileen Glynn*
Room 228	TRACK 7 / Session 7G (1:30–2:30); Session 7H (3:30–4:30)	Geotechnical instrumentation and foundation re-evaluation of John Day lock and Dam, Columbia River, Oregon-Washington *David Scofield*	A study of the long term performance of seepage cutoff barriers in dams *John Rice*	Design, construction, and performance of seepage barriers for Guanella Dam, near Empire, CO *John France*	Break	Sensitive infrastructure sites and structures - Sonic drilling offers quality control and non-destructive advantages to geotechnical construction drilling *John Davis*	Subgrade failure criteria according to soil type and moisture condition *Edel Cortez*	The automated stability monitoring of the Mississippi River levees using the range scan system *Robert Jolissian*
Room 229	TRACK 8 / Session 8G (1:30–2:30); Session 8H (3:30–4:30)	Damaging interactions among concrete materials *Toy Poole*	Economic effects on construction of uncertainty in test methods *Toy Poole*	Major issues in materials specifications *Toy Poole*	Break	Spall and intermediate-sized repairs for PCC pavements *Reed Freeman*	Acceptance criteria for unbonded aggregate road surfacing materials *Reed Freeman*	Effective partnering to overcome an interruption in the supply of Portland cement during construction of Marmet lock and Dam *Billy Neeley*

Thursday, August 4, 2005 Concurrent Sessions

Geotechnical, Specifications, Electrical & Mechanical Engineering & Construction Tracks

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:30 AM	11:00 AM	11:30 AM
Room 225	**TRACK 9 Geotechnical** Session 9E / Session 9F	Seepage Committee Meeting *GROUP DISCUSSION*	Seepage Committee Meeting (Continued) *GROUP DISCUSSION*	Seepage Committee Meeting (Continued) *GROUP DISCUSSION*	Break in Exhibit Hall	GMCoP Forum *GROUP DISCUSSION*	GMCoP Forum (Continued) *GROUP DISCUSSION*	GMCoP Forum (Continued) *GROUP DISCUSSION*
Room 232	**TRACK 21 Specifications** Session 21E / Session 21F	SpecsIntact-Demonstration of the SI explorer, publishing to PDF and Word *Patricia Robinson*	SpecsIntact - Demonstration of the SI editor, UMRL and reference wizard *Patricia Robinson*	UFGS status and direction *Jim Quinn*	Break in Exhibit Hall	UFGS transitin to Master-Format 2004 *Carl Kersten*	Project specifications for the upper tier Folsom outlet works modifications *Steve Freitas*	UFGS dredging *Don Carmen*
Room A	**TRACK 15 Military Electrical** Session 15E / Session 15F	Electronic Security *Tri-Service Panel*	Electronic Security (Continued) *Tri-Service Panel*	AIRFIELD lightning protection & grounding and lighting *Tri-Service Panel*	Break in Exhibit Hall	Electrical safety and arc flash UFC *Tri-Service Panel*	Electrical safety and arc flash UFC (Continued) *Tri-Service Panel*	Electrical infrastructure in Iraq - Restore Iraqi electricity *Joseph Swiniarski*
Room B	**TRACK 16 Military Mechanical** Session 16E / Session 16F	Lon works technology update *David Schwenk*	BACnet Technology Update *David Schwenk*	Implementation of Lon-based specifications *Will White*	Break in Exhibit Hall	Prefabricated Chiller Plants *Trey Austin*	Seismic for ME systems *Greg Stutts*	Design considerations for the prevention of mold *Quinn Hart*
Room D	**TRACK 17 Civil Mechanical** Session 17E / Session 17F	Lessons learned on flood water pump stations *Mark Robertson*	Armada of pump stations, Grand Forks and East Grand Forks *Timothy Paulus*	Various screen equipment selection guide *Sara Benier*	Break in Exhibit Hall	Lock gate replacement system *Will Smith*	Lock gate replacement system (Continued) *Will Smith*	Automated closure gate design for Duck creek flood control *Mark Robertson*
Room 230	**TRACK 19 Construction** Session 19E / Session 19F	NAVFAC Construction scheduling *Glenn Saito*	NAVFAC Construction scheduling (Continued) *Glenn Saito*	ACASS/CASS - CPARS *Ed Marceau*	Break in Exhibit Hall	Self-consolidating concrete *Beatrix Kerhoff*	Self-consolidating concrete (Continued) *Beatrix Kerhoff*	
Room 231	**TRACK 20 Construction** Session 20E / Session 20F	Update on DAWIA and Facilities Engineering *Mark Grammer*	Update on DAWIA and Facilities Engineering (Continued) *Mark Grammer*	Partnering as a best practice *Ray DuPont*	Break in Exhibit Hall	S&A Update *Harry Jones*	Construction Issues Open Forum (Q&A) *Don Basham*	Construction Issues Open Forum (Q&A) (Continued) *Don Basham*

12 Noon — **Lunch**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM
Room 225	**TRACK 9 Geotechnical** Session 9G	Seismic Manual *GROUP DISCUSSION*	Seismic Manual (Continued) *GROUP DISCUSSION*	Seismic Manual (Continued) *GROUP DISCUSSION*				

Thursday, August 4, 2005 Concurrent Sessions

Dam Safety Track & Structural Engineering Track

Room	Track / Session	8:00 AM	8:30 AM	9:00 AM	9:30 AM	Track / Session	10:30 AM	11:00 AM	11:30 AM
Room 224	**TRACK 10** Dam Safety — Session 10E	Seepage and stability, final evaluation for reservoir pool raising project, Terminus Dam, Kaweah River, CA — *Michael Ramsbotham*	Initial filling plan, Terminus dam spillway enlargement, Terminus Dam, Kaweah River, CA — *Michael Ramsbotham*	Hydrologic aspects of operating in a "failure mode" - Fern Ridge Lake, OR — *Bruce Duffe*	Break in Exhibit Hall	**TRACK 10** Dam Safety — Session 10F	A dam safety study involving cascading dam failures — *Gordon Lance*		The relationship of seismic velocity to the erodibility index — *Joseph Topi*
Room 240	**TRACK 12** Civil Works Structural — Session 12E	London lock and dam, West Virginia major rehabilitation project — *David Sullivan*	Replacing existing lock 4-Innovative designs for Charleroi lock — *Steveb Stoltz*	Use of non-linear incremental structural analysis in the design of the Charleroi lock — *Randy James*	Break in Exhibit Hall	**TRACK 12** Civil Works Structural — Session 12F	Olmsted dam in-the-wet construction methods — *Lynn Raque*	Completion of the Olmstead approach walls — *Terry Sullivan*	John Day lock monolith repair — *Mathew Hanson*
Room 241	**TRACK 13** Civil Works Structural — Session 13E	Chicago shoreline project — *Jan Plachta*	Structural assessment of Bluestone Dam — *Robert Reed*	Duck Creek, OH local flood protection projection phase III Culvert damage — *Jeremy Nichols*	Break in Exhibit Hall	**TRACK 13** Civil Works Structural — Session 13F	Development of design criteria for the Rio Puerto Nuevo contract 2D/2E channel wall — *Jana Tanner*	Design of concrete lined tunnels in rock — *David Force*	Indianapolis north phase IIIA project — *Gene Hoard*
Room 242	**TRACK 14** Bridges/ Buildings — Session 14E	Urban search & rescue program overview — *Tom Niedernhofer*	Evaluation and repair of blast damaged reinforced concrete beams — *John Hudson*	Single degree of freedom blast effects spreadsheets — *Dale Nebuda*	Break in Exhibit Hall	**TRACK 14** Bridges/ Buildings — Session 14F	UFC 4-023-02 Structural design to resist explosive effects for existing buildings — *Jim Caulder*	Progressive collapse UFC requirements — *Brian Crowder*	U.S. general services admnistrative progressive collapse design guidelines applied to concrete moment-resisting frame buildings — *David Billow*

12 Noon — **Lunch**

Room	Track / Session	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Track / Session	3:30 PM	4:00 PM	4:30 PM
Room 224	**TRACK 10** Dam Safety — Session 10G	Dam safety instrumentation data management utilizing WinIDP to aid data collection and evaluation — *Travis Tutka*	Automated instrumentation assessments at Marmet lock & Dam — *Ronald Rakes*	Potential failure mode analysis of Eau Galle Dam — *David Rydeen*	Break	**TRACK 10** Dam Safety — Session 10H	Dam safety officers panel - The Good — *Bruce Murray*	Dam safety officers panel - The Bad — *Bruce Murray*	Dam safety officers panel - The Ugly — *Bruce Murray*
Room 240	**TRACK 12** Civil Works Structural — Session 12G	Inner Harbor navigation canal and lock structure — *Mark Gonski*	Design features and challenges of the Comite River diversion project — *Christopher Dunn*	Waterline support failure on the Harvey canal: A case study — *Angela DeSoto Duncan*	Break	**TRACK 12** Civil Works Structural — Session 12H	Public appeal of major civil projects- The good, the bad and the ugly — *Kevin Holden*	Des Moines Riverwalk — *Thomas Heinold*	Chickamauga lock and Dam height optimization study using Monte Carlo simulation — *Leon Schieber*

Thursday, August 4, 2005 Concurrent Workshops

Room	Workshop	1:30 PM	2:00 PM	2:30 PM	3:00 PM	Workshop	3:30 PM	4:00 PM	4:30 PM
Room 241	**Workshop 1** DoD Security Engineering **Session 1A**	Security planning & minimum standards *Curt Betts*	Security planning & minimum standards (Continued) *Curt Betts*	Security planning & minimum standards (Continued) *Curt Betts*	Break	**Workshop 1** DoD Security Engineering **Session 1B**	Security design manuals *Bernie Deneke*	Security design manuals (Continued) *Bernie Deneke*	Security design manuals (Continued) *Bernie Deneke*
Room 231	**Workshop 2** Electrical Workshop **Session 2A**	National Electrical Code 2005 Changes *Mark McNamara*	National Electrical Code 2005 Changes (Continued) *Mark McNamara*	National Electrical Code 2005 Changes (Continued) *Mark McNamara*		**Workshop 2** Electrical Workshop **Session 2B**	National Electrical Code 2005 Changes (Continued) *Mark McNamara*	National Electrical Code 2005 Changes (Continued) *Mark McNamara*	National Electrical Code 2005 Changes (Continued) *Mark McNamara*
Room 242	**Workshop 3** Mechanical Engineering **Session 3A**	Design and application of packaged central cooling plants *The Trane Company*	Design and application of packaged central cooling plants (Continued) *The Trane Company*	Design and application of packaged central cooling plants (Continued) *The Trane Company*		**Workshop 3** Mechanical Engineering **Session 3B**	Improving dehumidification in HVAC systems *The Trane Company*	Improving dehumidification in HVAC systems (Continued) *The Trane Company*	Improving dehumidification in HVAC systems (Continued) *The Trane Company*
Room 230	**Workshop 4** Construction **Session 4A**	Construction Community of Practice Forum *Walt Norko*	Construction Community of Practice Forum (Continued) *Walt Norko*	Construction Community of Practice Forum (Continued) *Walt Norko*					
Room 232	**Workshop 5** Specifications **Session 5A**	Open Meeting of Corps Specifications Steering Committee *Robert Iseli, et al.*	Open Meeting of Corps Specifications Steering Committee (Continued) *Robert Iseli, et al.*	Open Meeting of Corps Specifications Steering Committee (Continued) *Robert Iseli, et al.*		**Workshop 5** Specifications **Session 5B**	Open Meeting of Corps Specifications Steering Committee (Continued) *Robert Iseli, et al.*	Open Meeting of Corps Specifications Steering Committee (Continued) *Robert Iseli, et al.*	Open Meeting of Corps Specifications Steering Committee (Continued) *Robert Iseli, et al.*

NOTES

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION

STRENGTH THROUGH INDUSTRY & TECHNOLOGY

2005 Tri-Service Infrastructure Systems Conference & Exhibition
"Re-Energizing Engineering Excellence"
August 2-4, 2005
St. Louis, MO

US Army Corps
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Chicago District

HH&C, Track 4, Session 4G, Modeling, 1:30 pm Aug. 4

- *Rick D. Ackerson*
- **Hydraulic Engineer**
- ***U.S.* Army Corps of Engineers**
- **Chicago District**
- ***111 N. Canal St.***
- ***Chicago, IL 60606***
- **Phone: (312)-846-5511**
- **e-mail: rick.d.ackerson@usace.army.mil**
- **Fax:(312)-353-2156**

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Little Calumet River Unsteady Flow Model Conversion UNET to HEC-RAS

- Rick D. Ackerson
- Hydraulic Engineer
- U.S. Army Corps of Engineers
- Chicago District

US Army Corps
of Engineers
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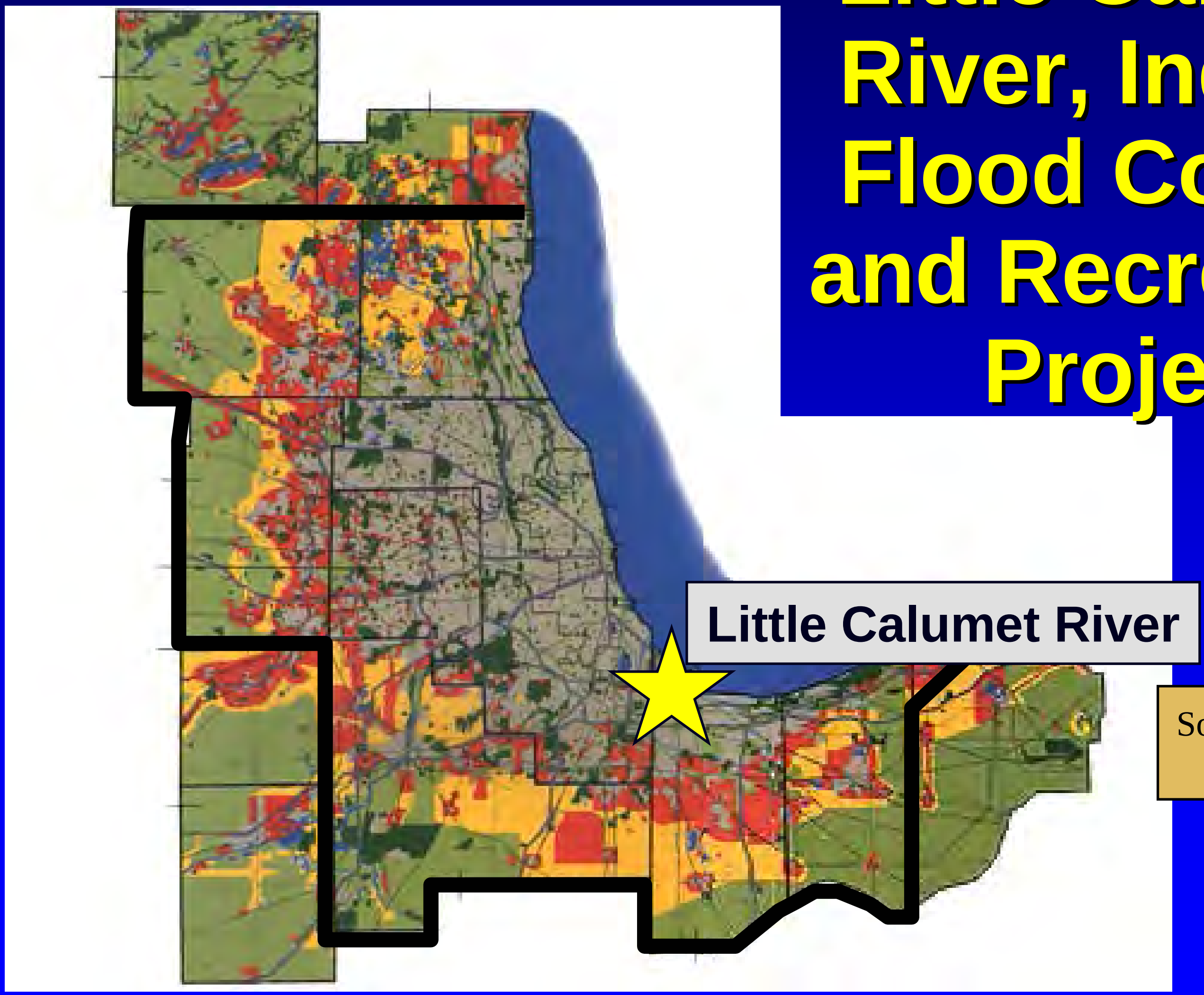
Little Calumet River, Indiana Flood Control and Recreation Project



Source: Openlands Project

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Project Description

Little Calumet River, Indiana

- Construct 22 miles of new urban levees
- Provides 200 year level of flood protection
- Construct 17 miles of hiking trails
- Fish and Wildlife mitigation - 550 acres of wetland
- Local Sponsor: Little Calumet River Basin Development Commission
- Authorization: WRDA 1986

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History of the Little Cal Models

- 1991 – Little Cal UNET model constructed from existing 1970's vintage HEC-2 and WSP-2 models HEC-1 was used to develop inflows
- 1995 – Deep River reach extended. Model recalibrated
- 2002 – Model converted from specialized Dr. Barkau version to the HEC version of UNET

  Updated to Bulletin 70/71 precipitation from TP-40 and recalibrated
- 2005 – HEC-UNET converted to HEC-RAS Updated special bridges to more detailed bridges

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Reasons for Model Conversions

- 2002 specialized UNET to HEC-UNET
  - **To update to the more standard Bulletin 70/71 precipitation**
  - **To update to the more accepted standard HEC-UNET (specialized version did not run on the Windows platform)**
- 2005 - HEC-UNET to HEC-RAS
  - **City of Gary requested new floodway mapping to reflect the Corps levee construction to date**
  - **FEMA requested conversion for ease of review and ease of floodway determination**
  - **State of Illinois showed interest in new floodway mapping to reflect the impacts of the new Thornton reservoir**

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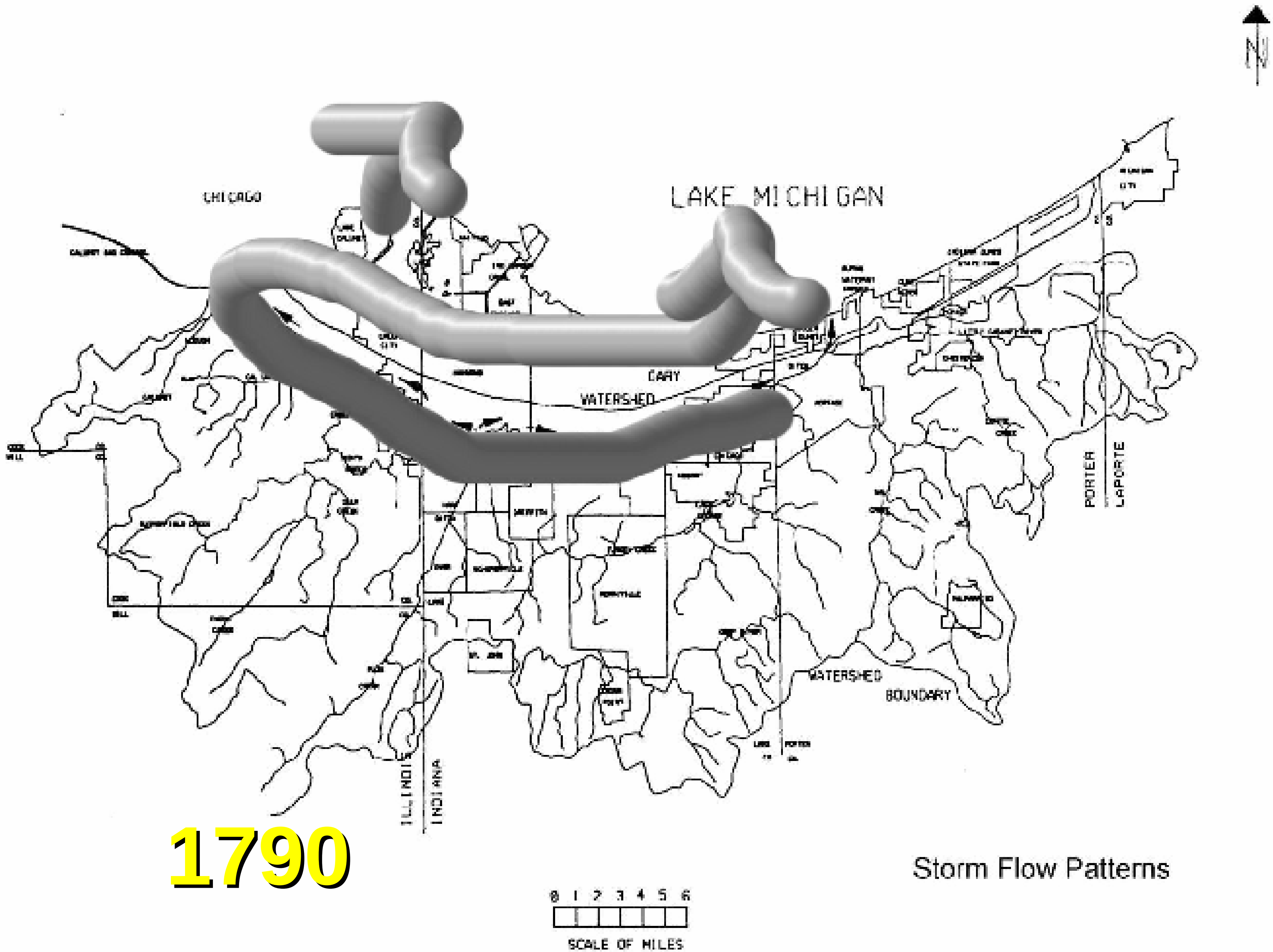
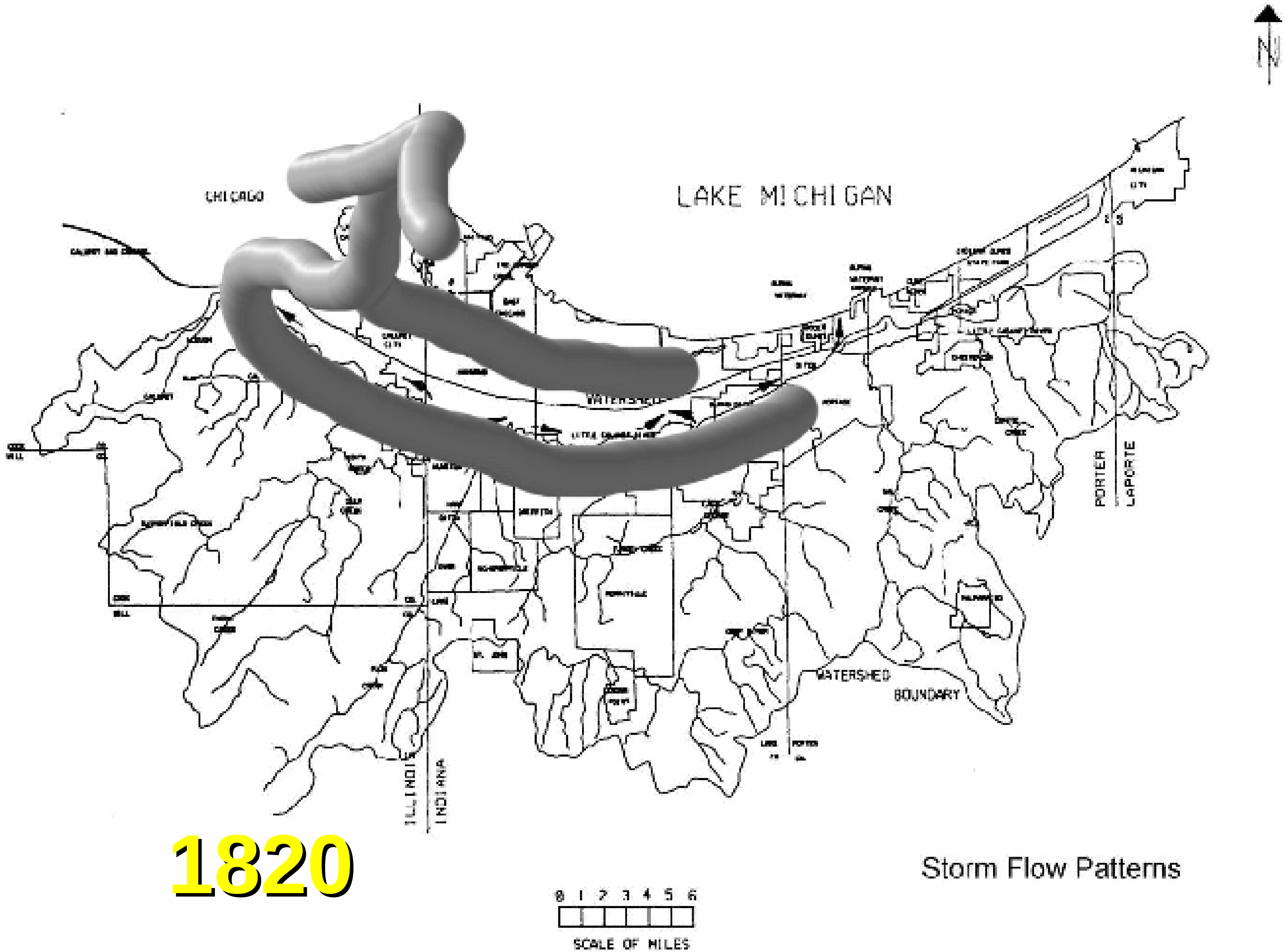
Various Uses for Little Calumet River Model

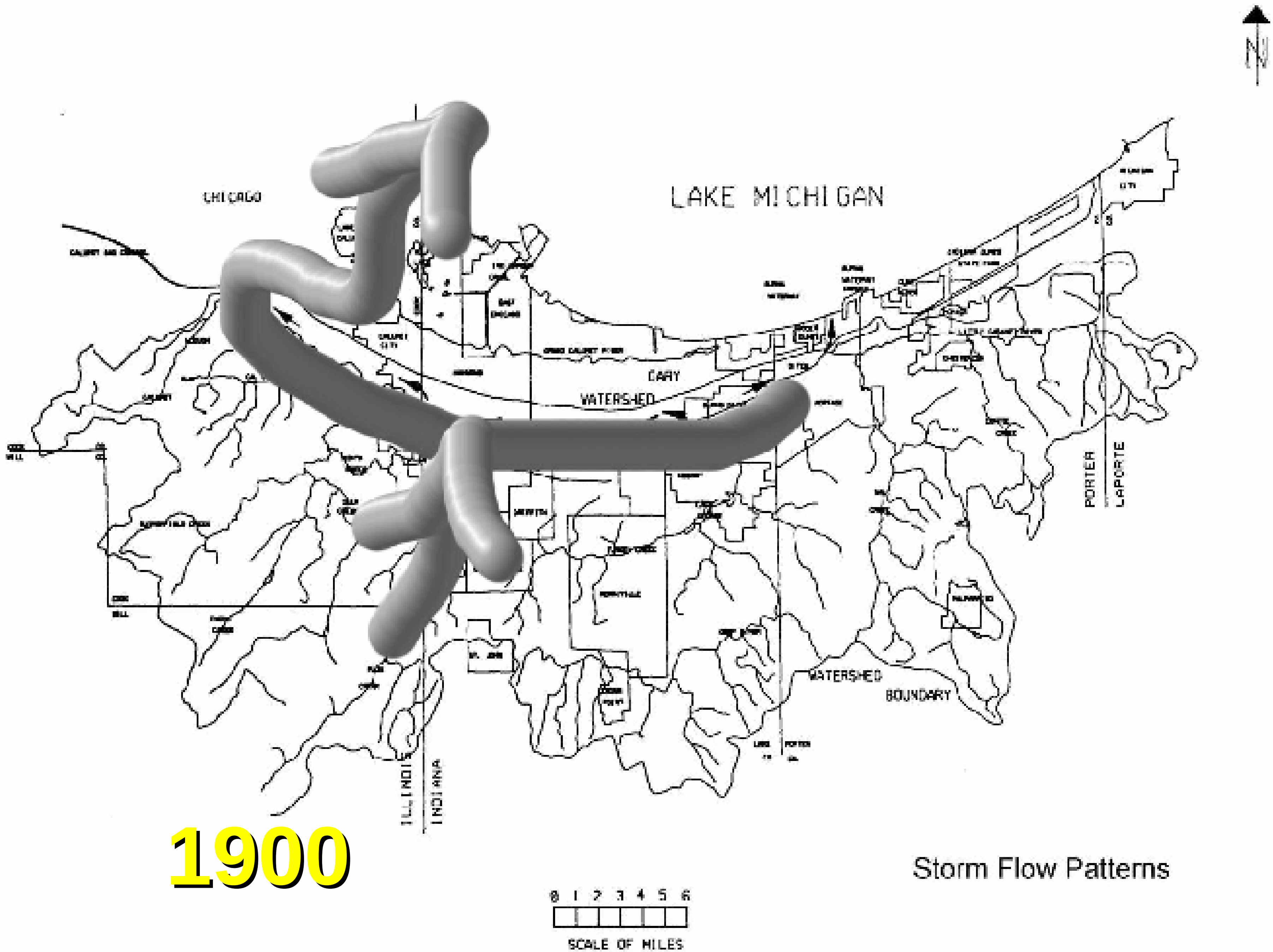
- Design Levee Height Superiority Analysis
- To determine impacts of various project features
- To develop the flood warning plan
- To determine the impact of staged construction
- To develop updated floodplain mapping for the city of Gary
- To develop updated floodplain mapping in Illinois



Storm Flow Patterns

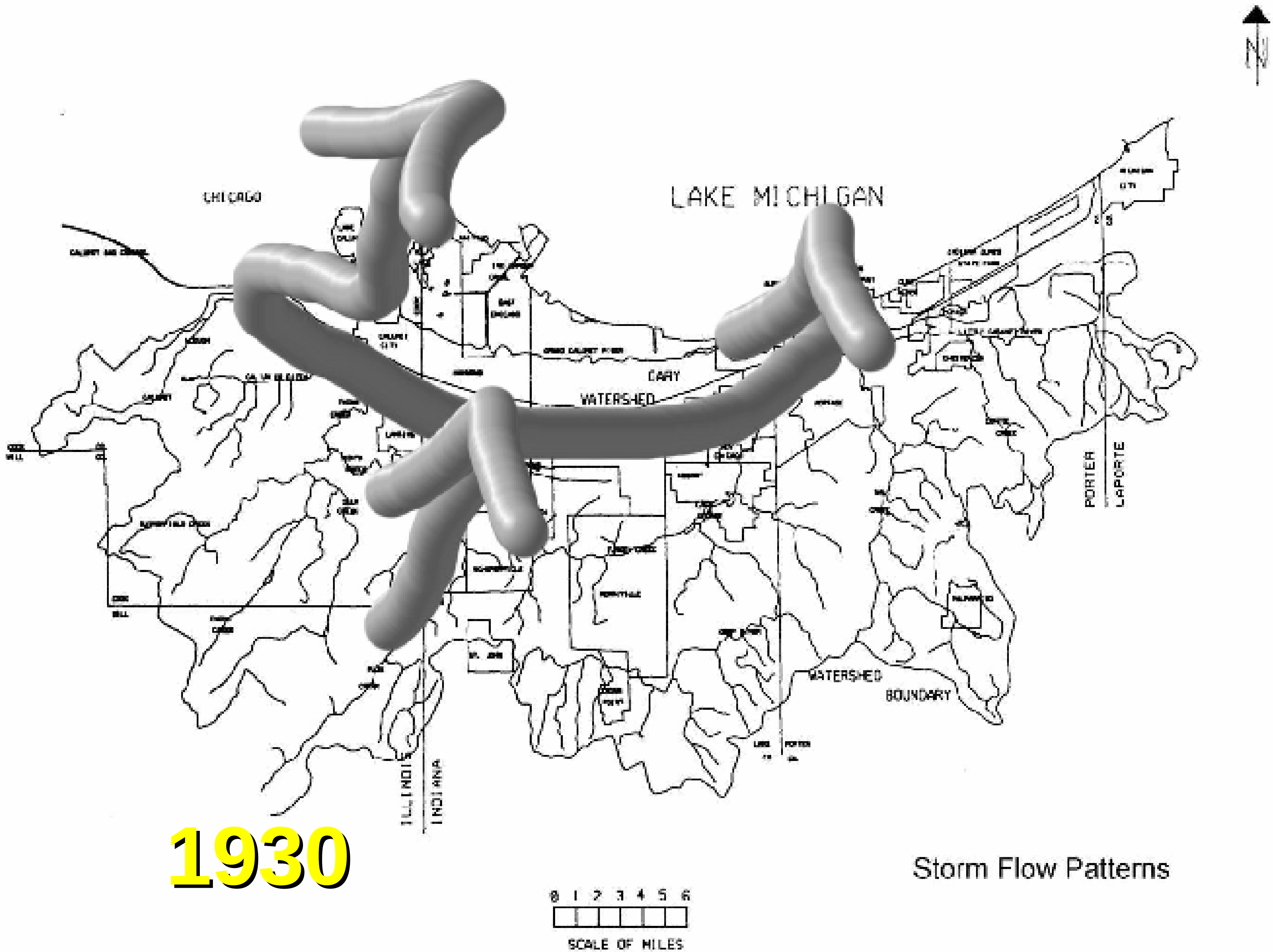


Storm Flow Patterns



1900

Storm Flow Patterns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CHICAGO
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Storm Flow Patterns
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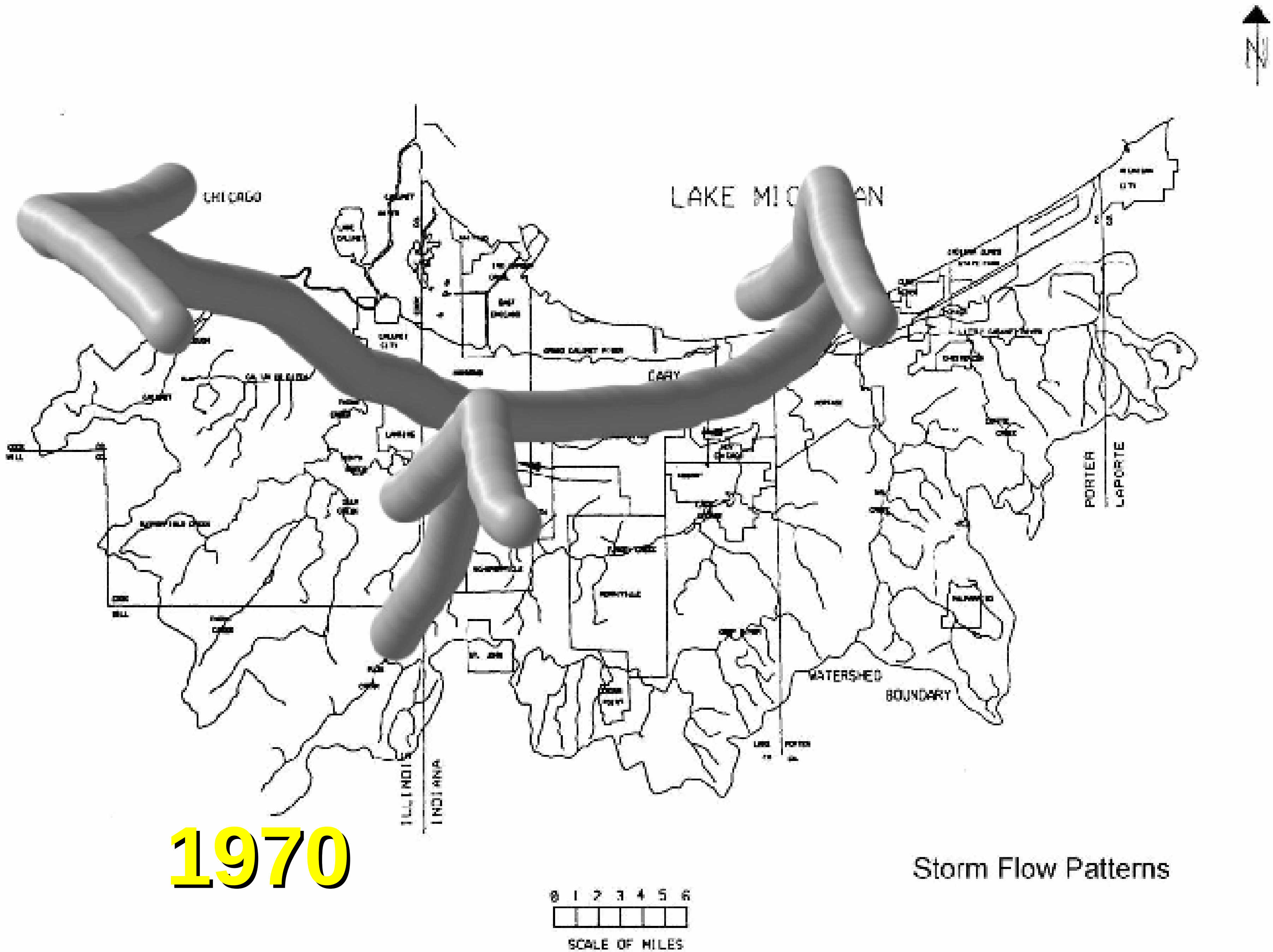

1970

Storm Flow Patterns

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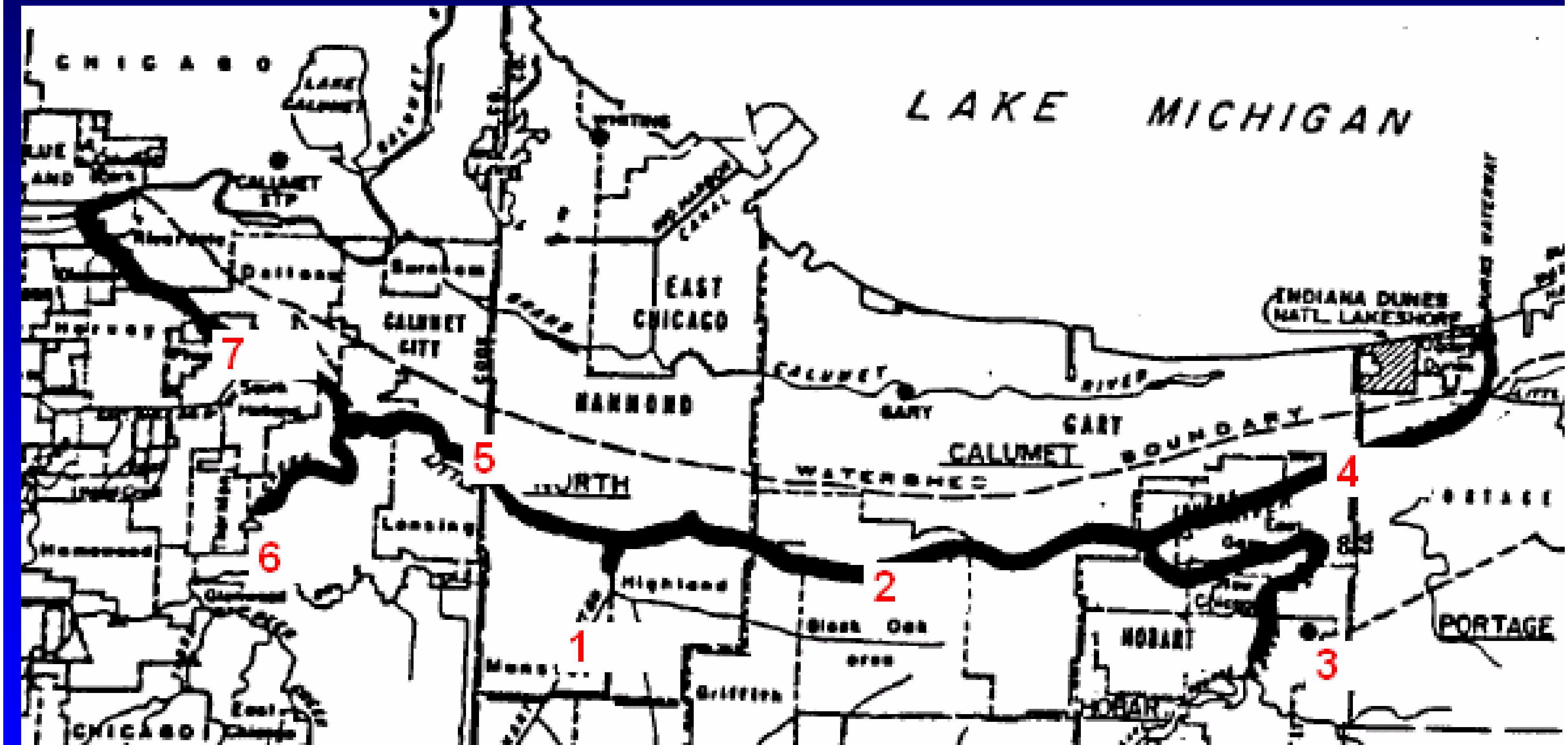
Little Cal Model



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Advantages of Unsteady Flow Model versus Steady State Modeling

- Flow Reversals
- Flow Splits
- Backwater Impacts
- Preferred channel routing technique for very flat channels

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Little Cal HEC-RAS Model

- 7 reaches
- 50.3 miles of river
- 493 cross sections
- 85 bridges
- 54 storage areas
- 4 inline structures
- 93 lateral connections
- 18 interconnections between storage areas

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Boundary Conditions/Storage System

- HEC-DSS for Flow and Stage Hydrograph Storage
- Rating Curves at the Cal-Sag and 10 year level at Lake Michigan
- Inflow Hydrographs at Thorn Creek, Hart Ditch, Deep River and East Arm Little Calumet River

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Little Cal Model Calibration

- Extensive high water data for 1989 and 1990 flood events
- Flow measurements during 1989 and 1990 flood events
- Observed flow and stage for 5 gages
- Observed stage for 2 gages
- Observed flow for 2 gages
- Long period of record (40+ years) for gages to develop stage and flow frequency curves

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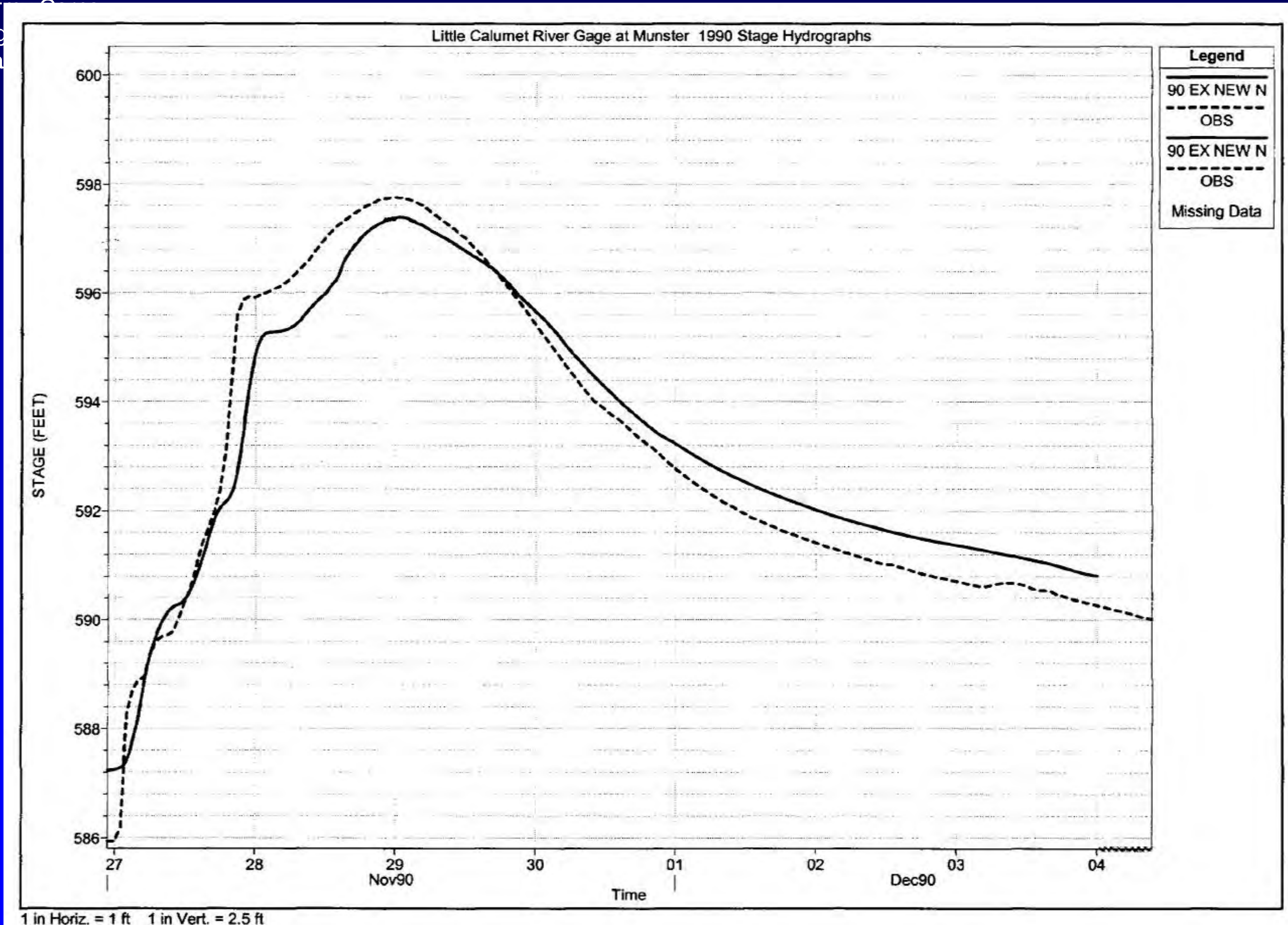

1990 Flow Hydrograph for Little Calumet River Gage at Munster

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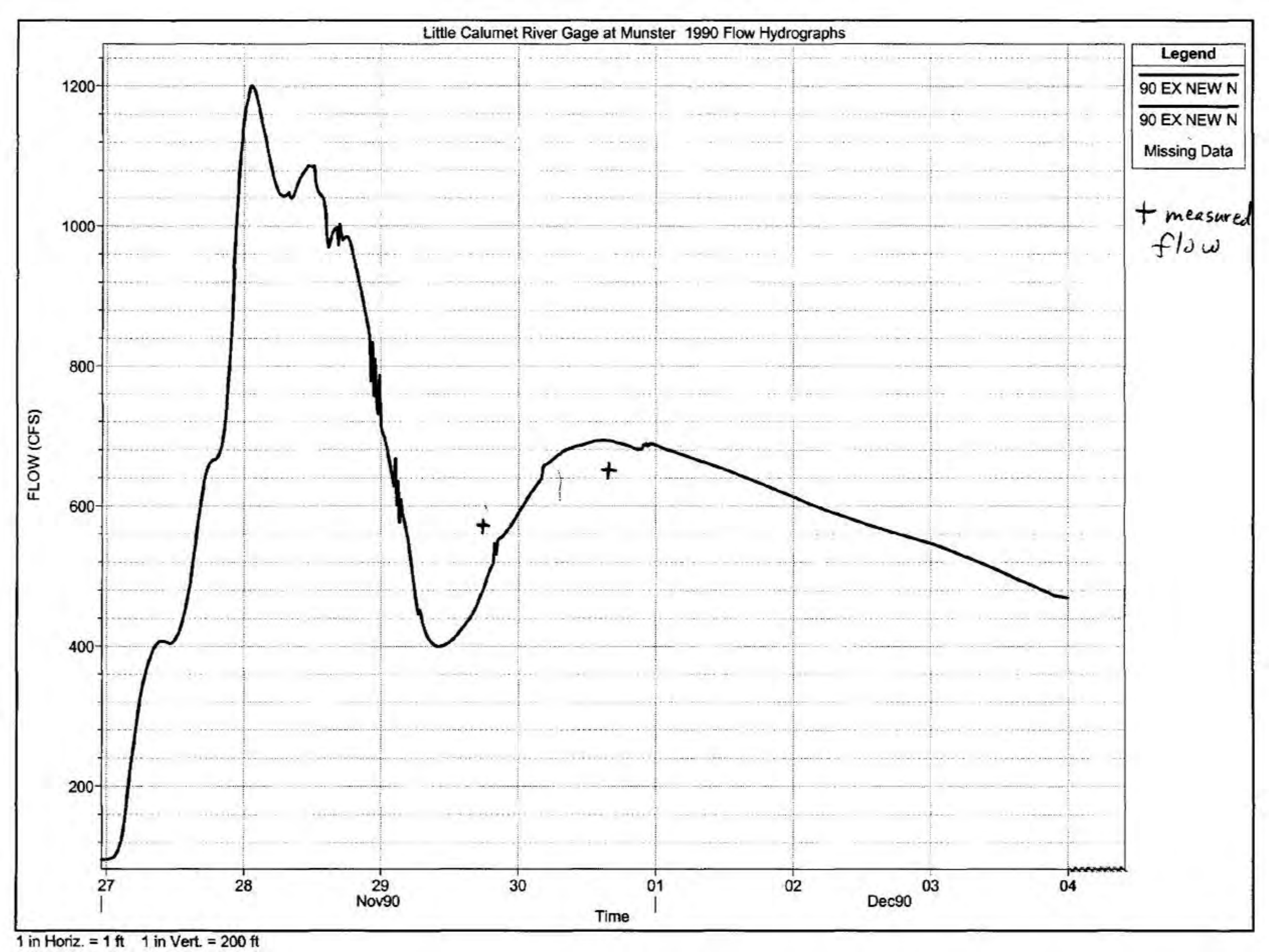

Little Calumet River at South Holland

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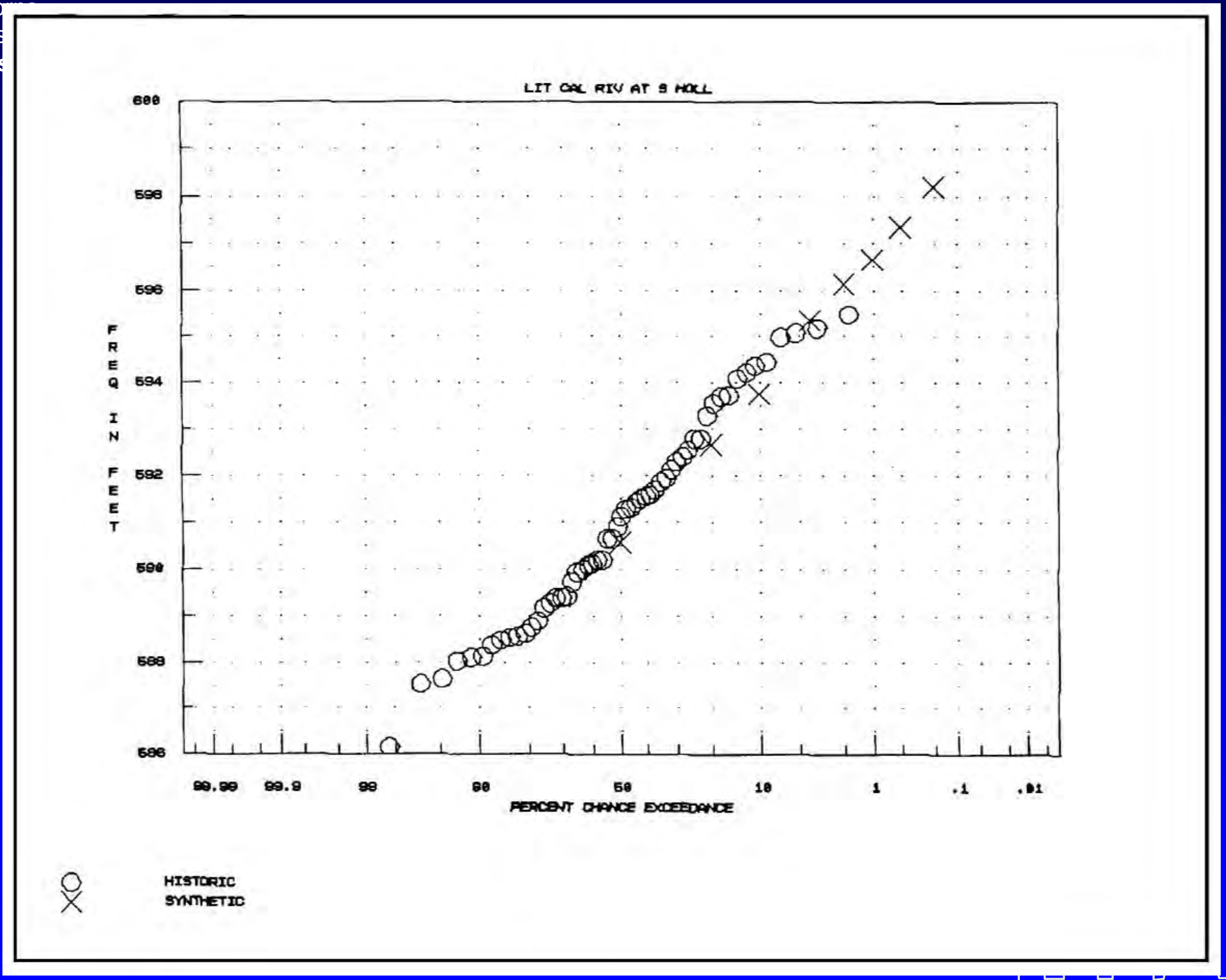

Hart Ditch Gage at Munster

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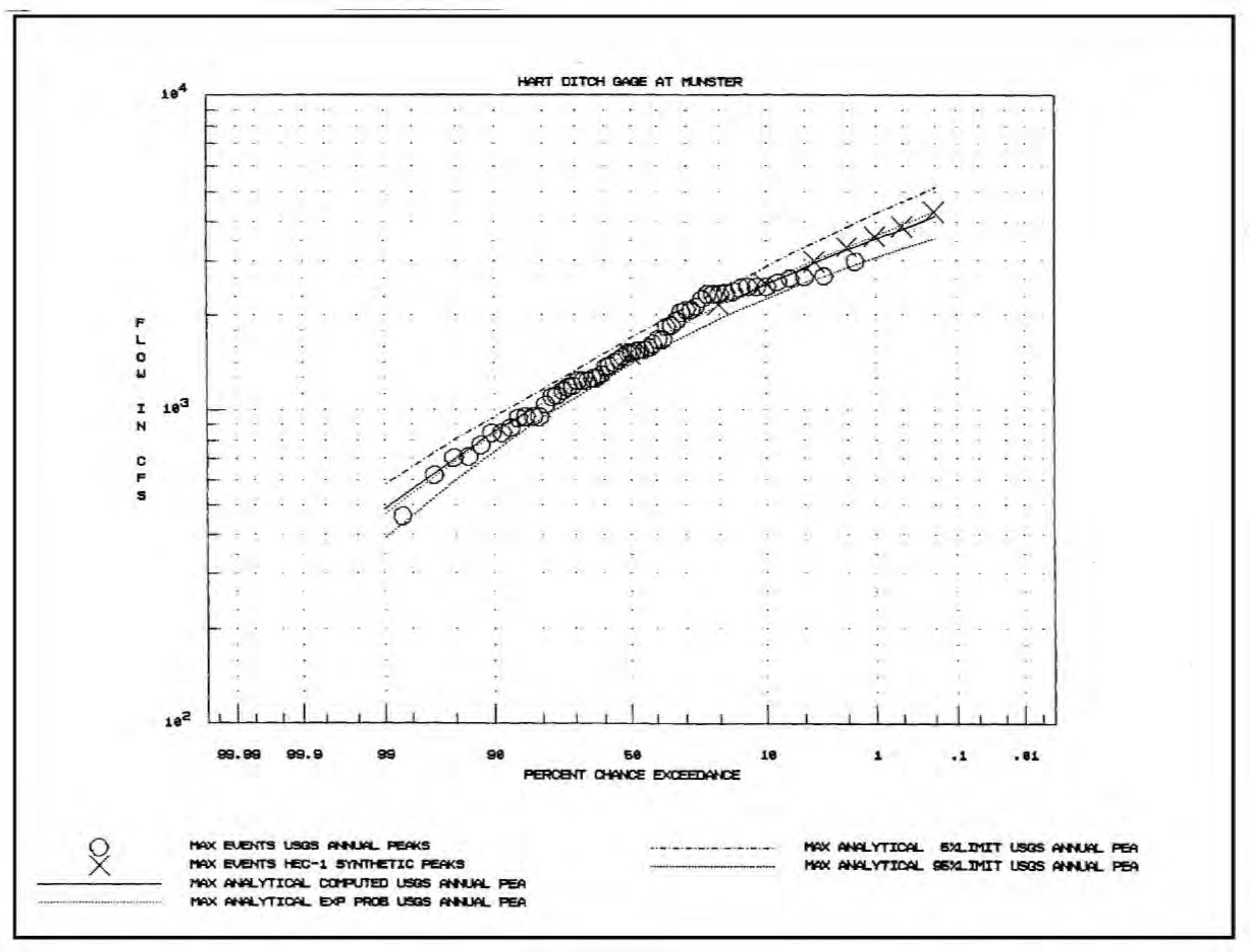

1990 Maximum Water Surface for Little Calumet River/Burns Ditch

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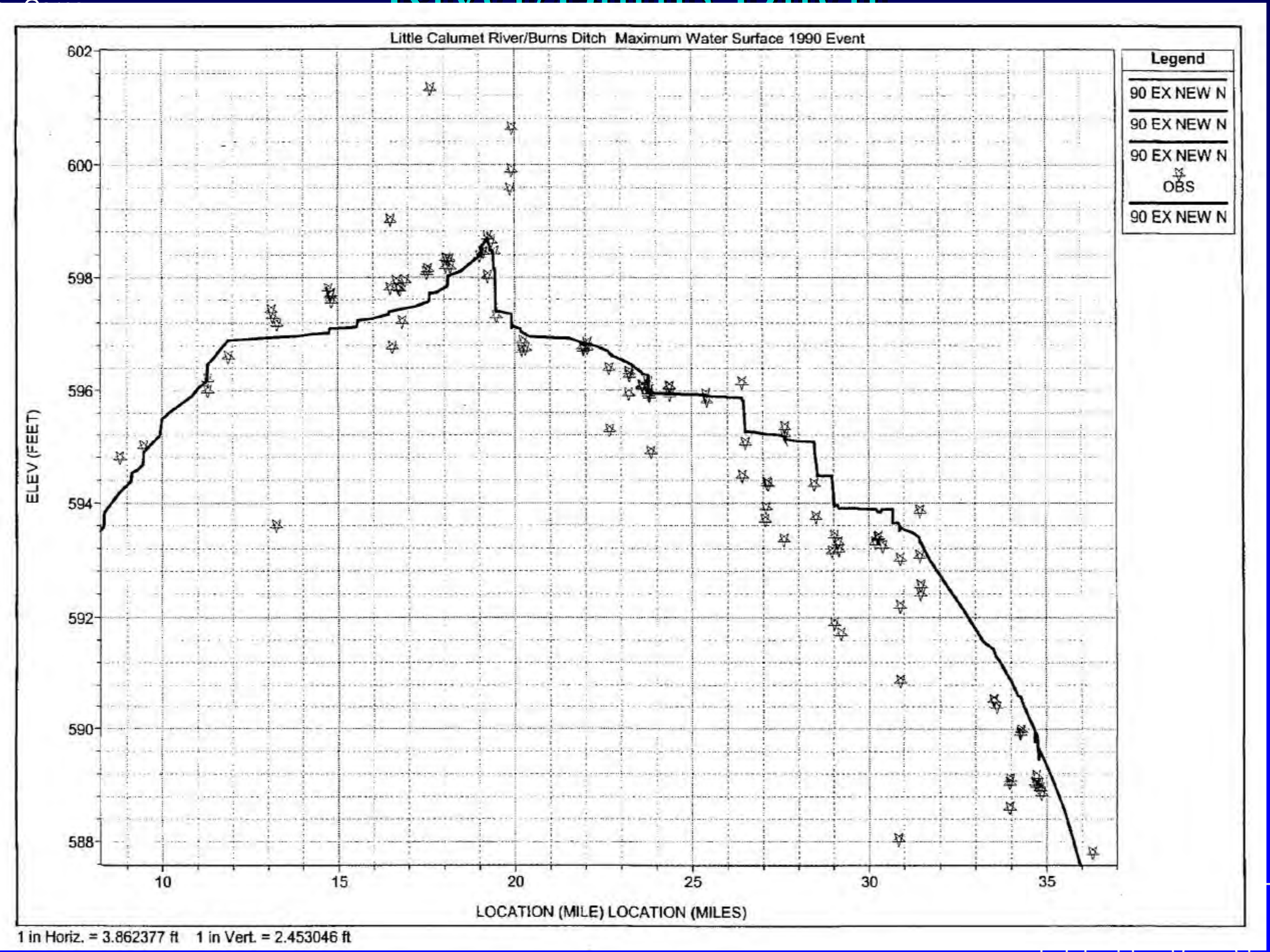

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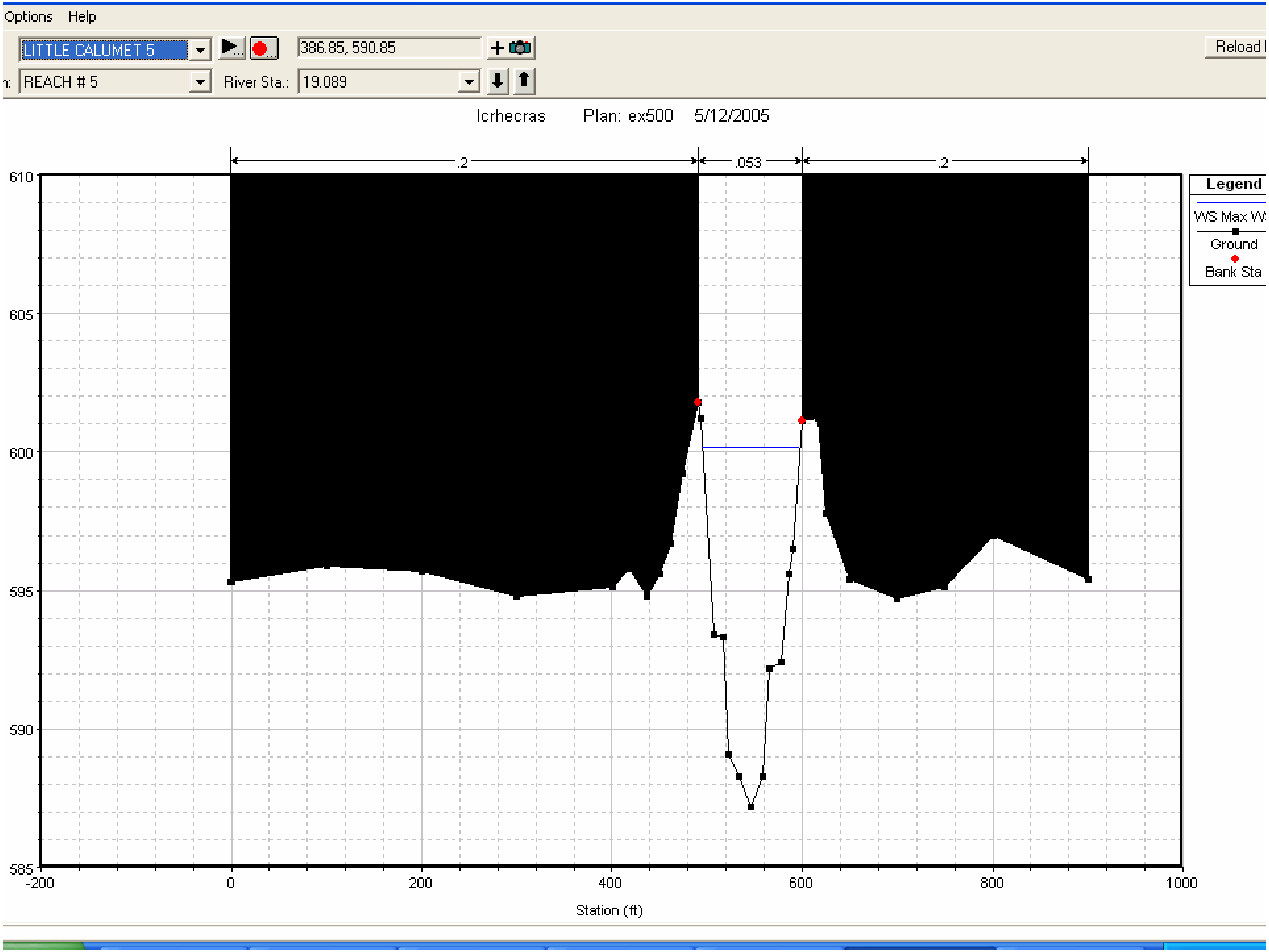
Project Conditions

- Bridge improvements
- Corps Levees
- Hart Ditch Control Structure
- Thorn Creek Reservoir
- Cady Marsh Ditch Diversion Tunnel

LITTLE CALUMET RIVER, INDIANA
FLOOD CONTROL AND RECREATION PROJECT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Linear Routing Connection

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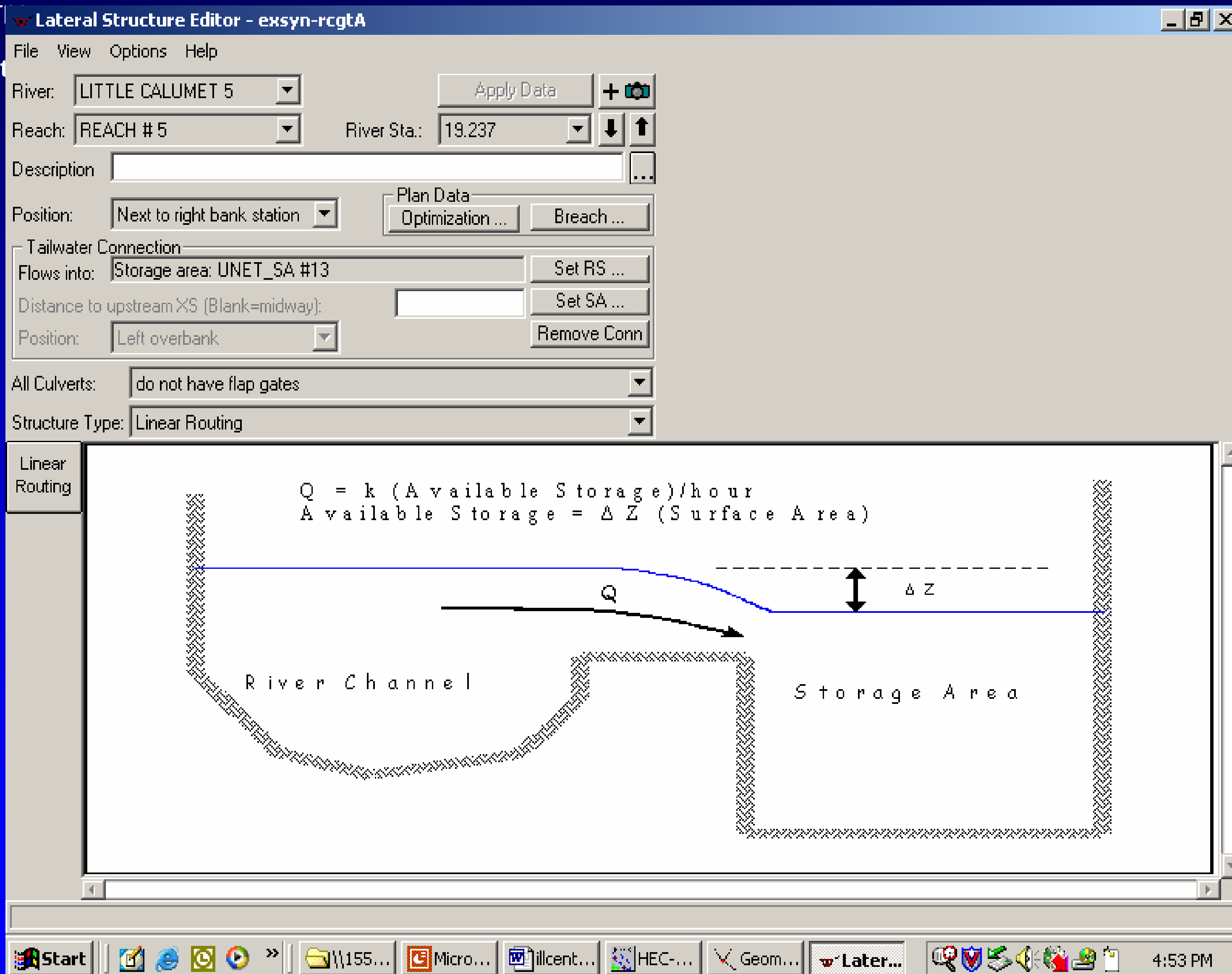

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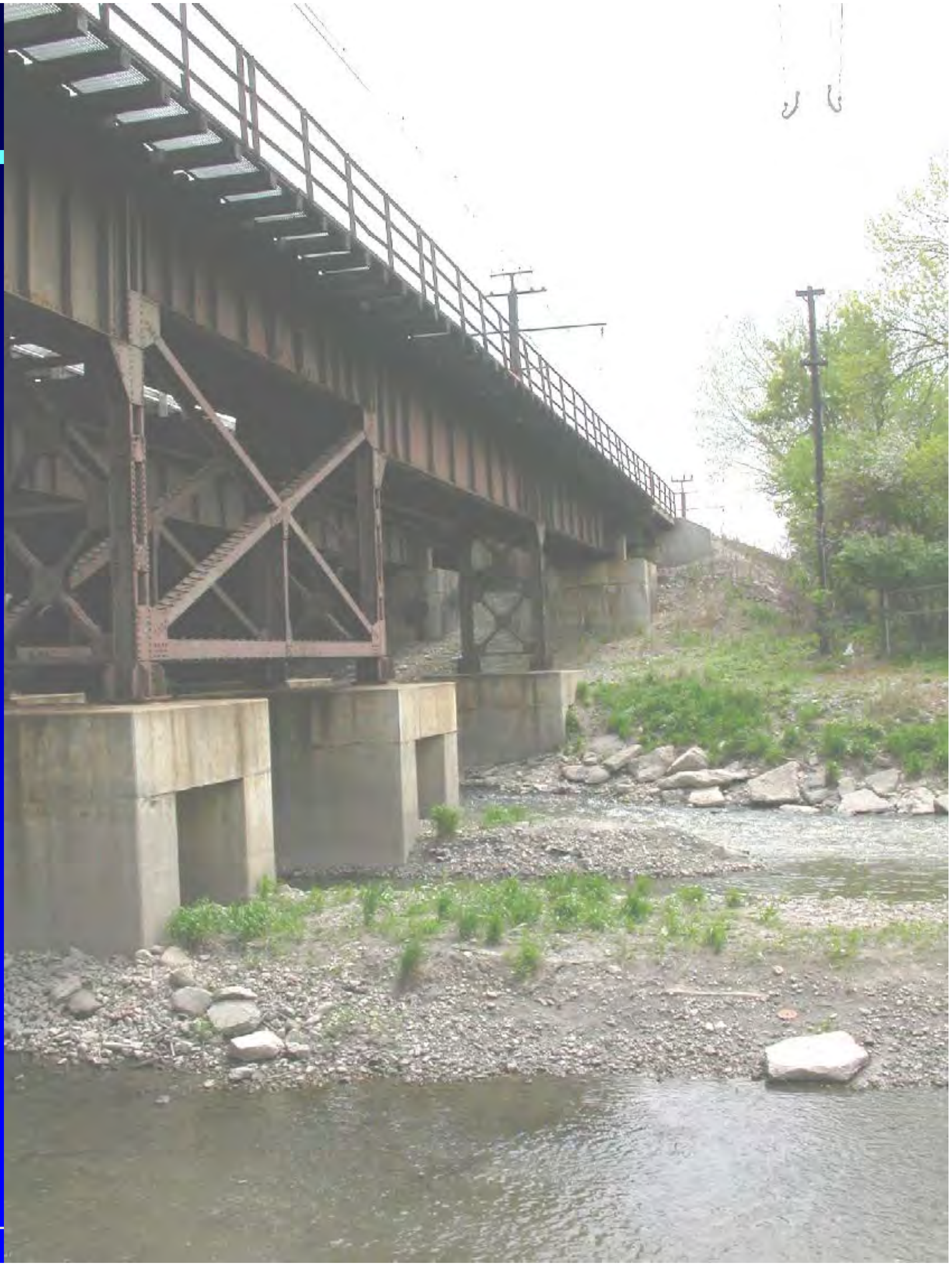
Illinois Central Railroad Bridge



Illinois Central Bridge (UNET)

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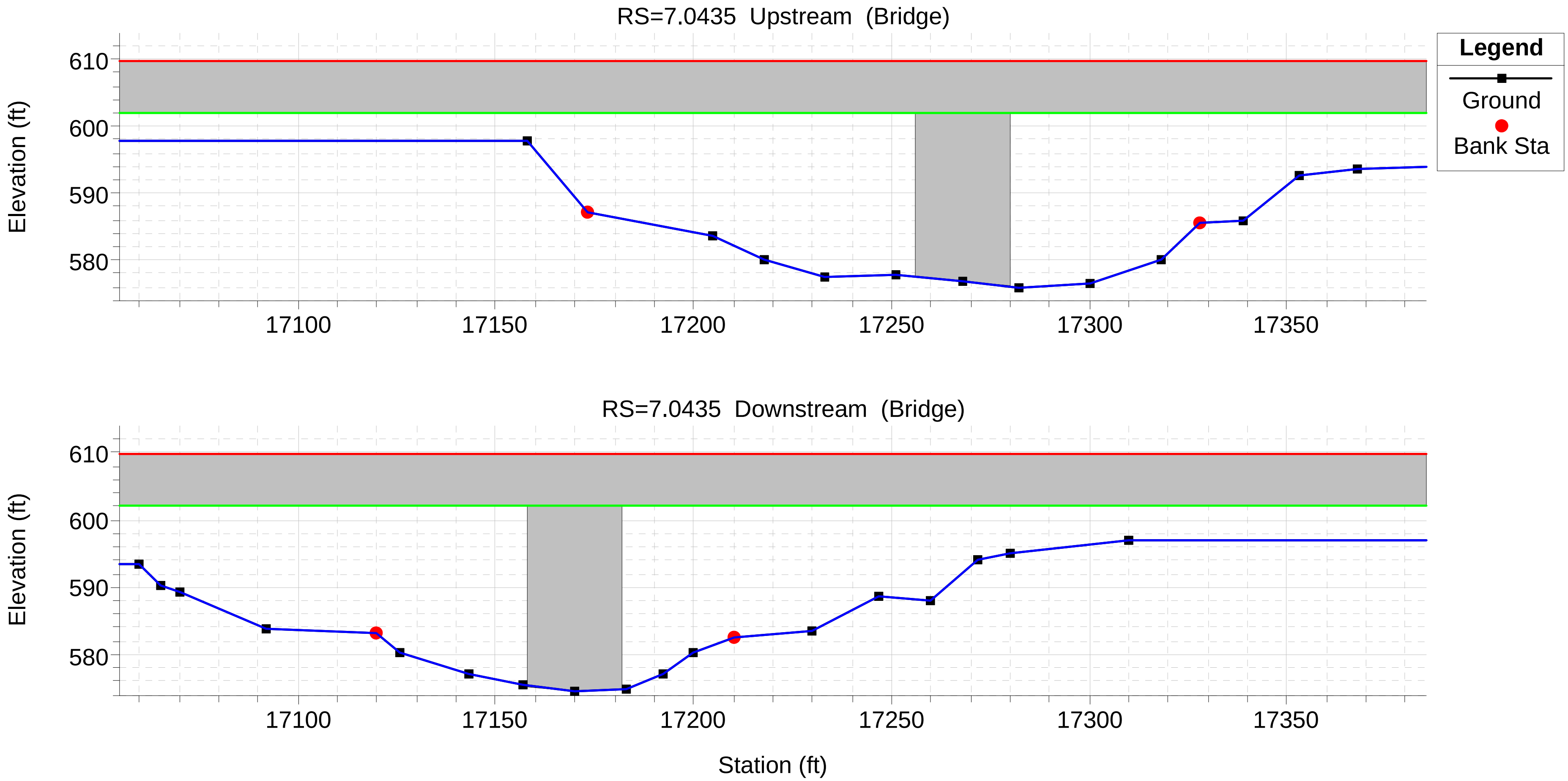

Illinois Central Bridge (HEC-RAS)

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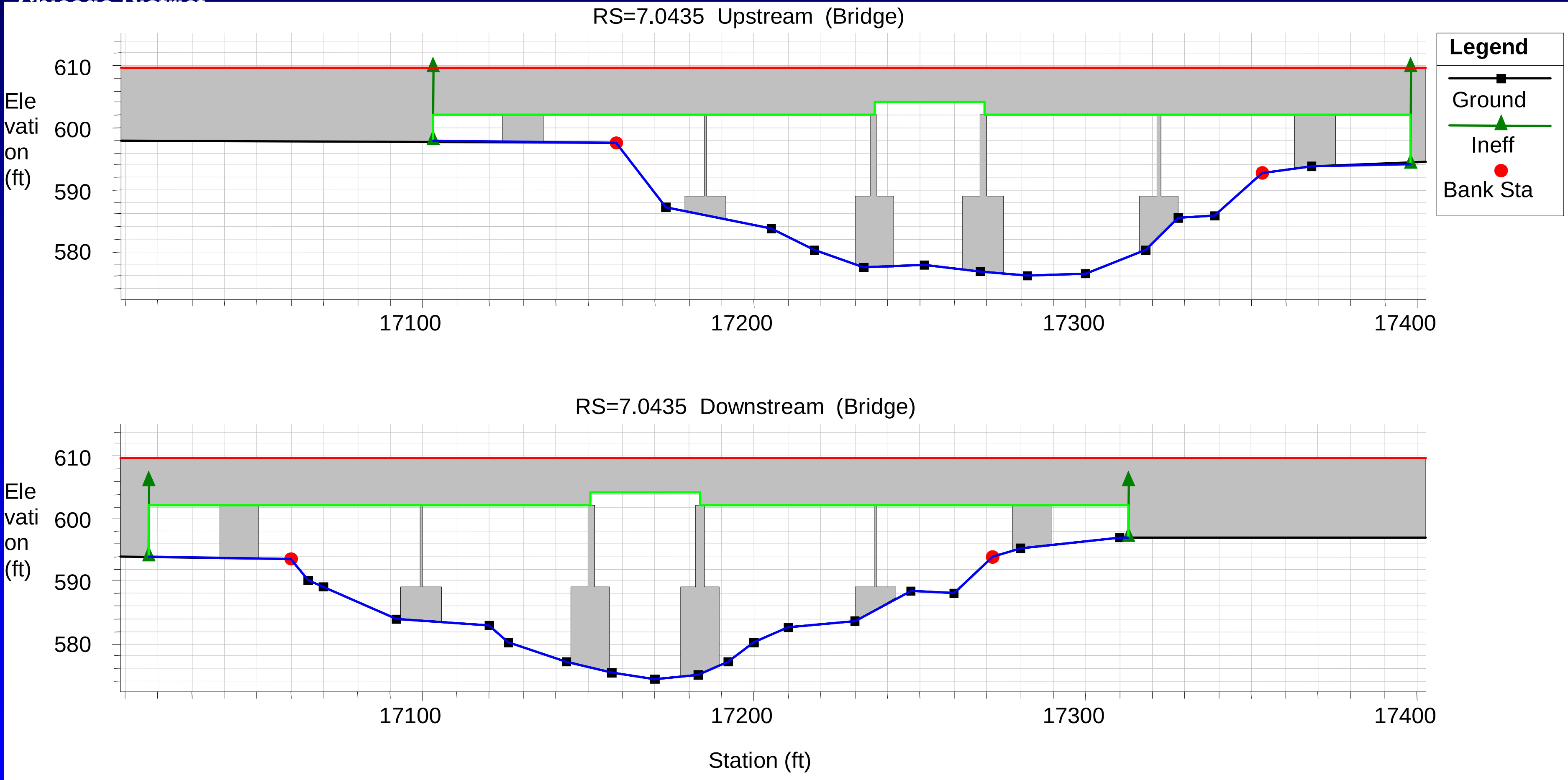

Calumet Expressway (UNET)

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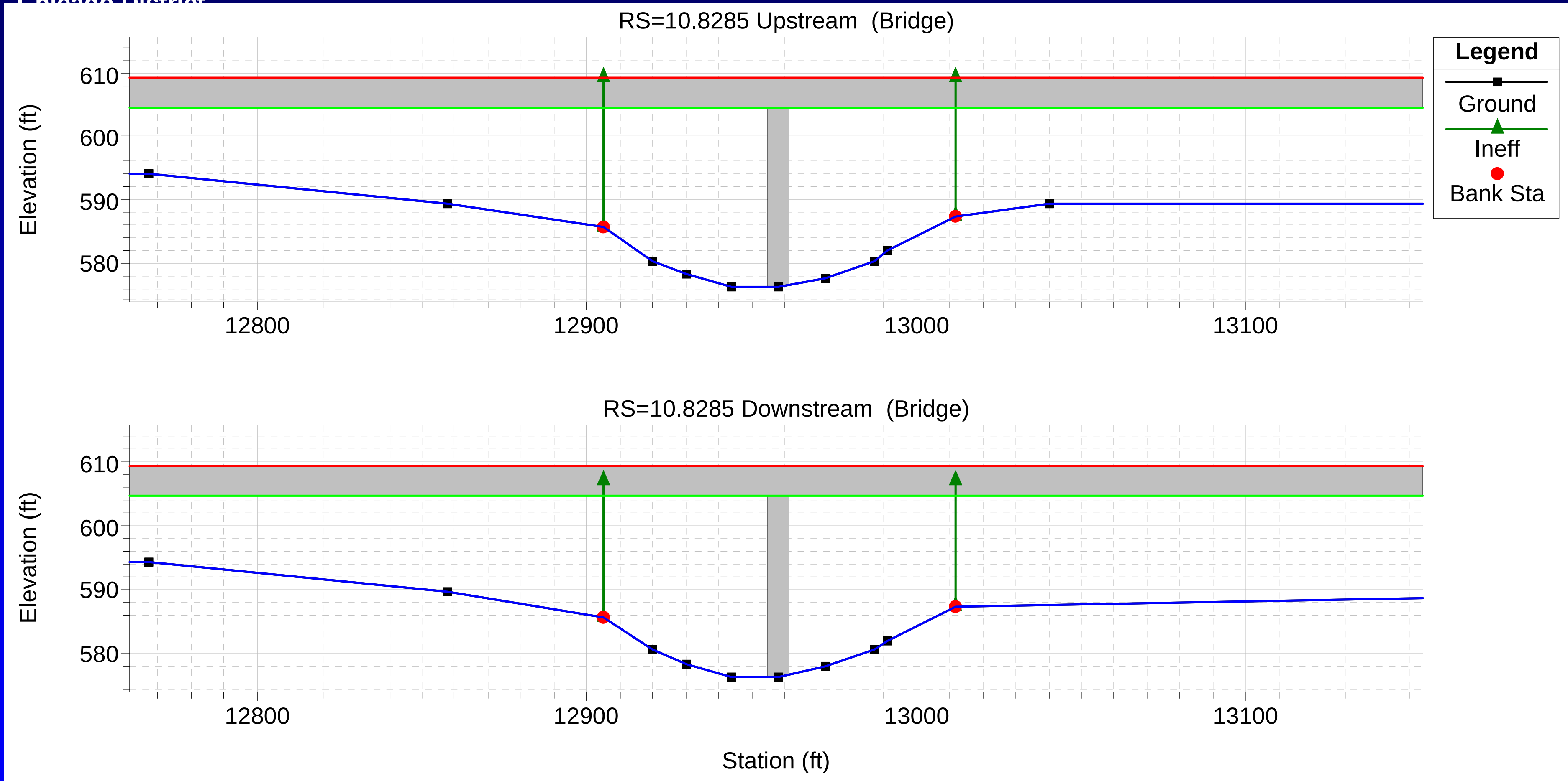

Calumet Expressway (HEC-RAS)

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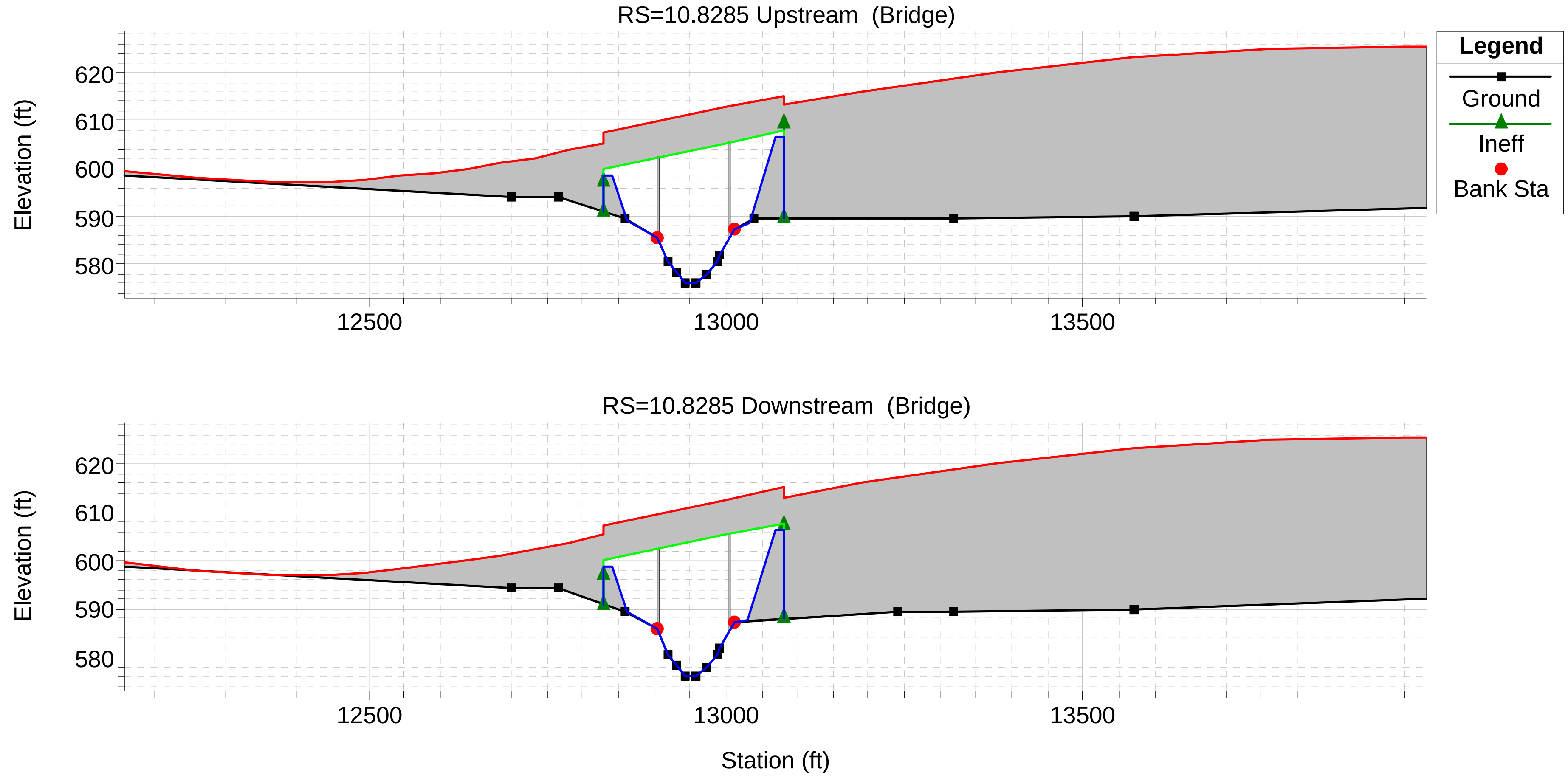

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UNET to HEC-RAS Model Conversion Challenges

- Automatic conversion did not work
- River miles renumbered (also channel relocation, differing river miles for project condition)
- Storage areas renumbered so reconnection and relabling required
- Linear Routing connections needed to be broken up
- Manual conversion of boundary condition file

Computational Hydraulic Model of the Lower Monumental Dam Forebay

Richard Stockstill, Charlie Berger, John Hite,
Alex Carrillo, & Jane Vaughan
Coastal & Hydraulics Laboratory

The ADH Model

Needs

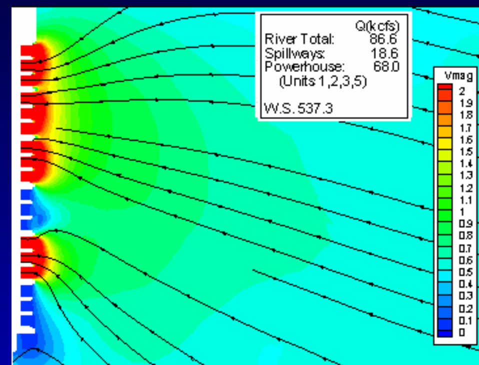
- Irregular boundaries and material distributions.
- Steep and moving gradients
- Interflow and lateral migration, heterogeneous infiltration and seepage, runoff.
- High resolution --- large algebraic systems to solve
- Portable to many computer architectures

Model Decisions

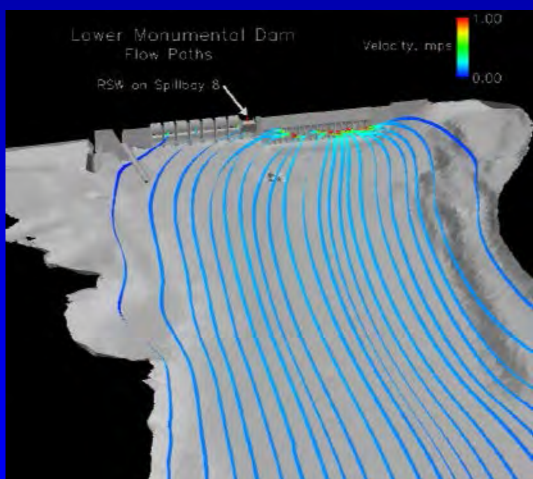
- Unstructured meshes
- Adaptive mesh refinement/coarsening
- Multi-physics coupling (groundwater/surface water).
- Parallel computing
- Assume distributed memory and standard message passing libraries

ADH Philosophy

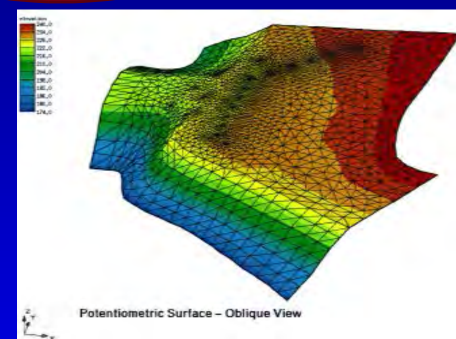
Navier-Stokes Equations

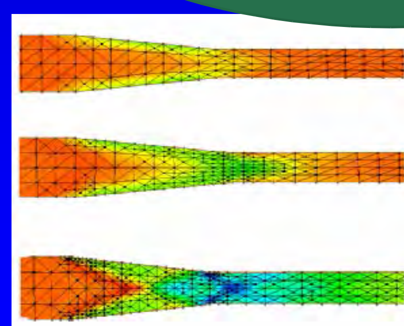


Unsaturated Groundwater Equations

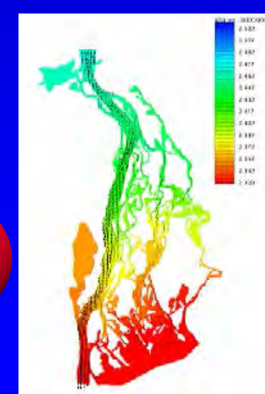


Computational Engine
(FE utilities, preconditioners, solvers, I/O to xMS GUIs)





Shallow Water Equations

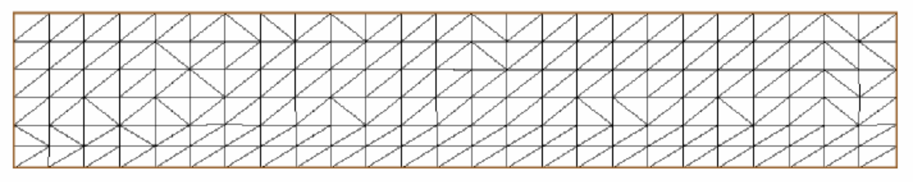


ADAPTIVE MESH

ADH - Adaption

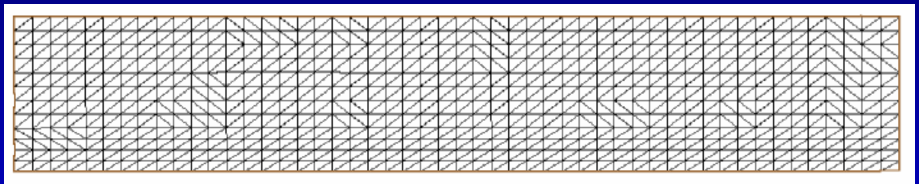
- Grid resolution required to match the differential equations
- High resolution likely only needed in select regions
- Intelligent adaption saves computational effort
- Adaption doesn’t require the user to have a reasonable idea of the solution ahead of time

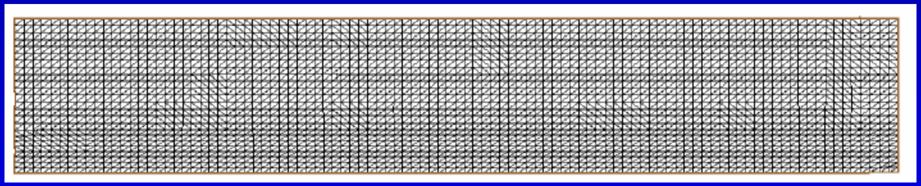
How important is grid resolution?



Coarse Mesh
182 nodes/300 elements

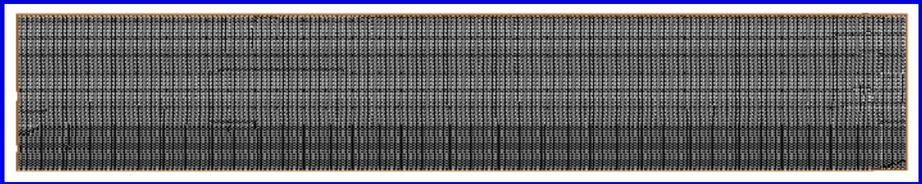
Refined Mesh #1
663 nodes/1200 elements





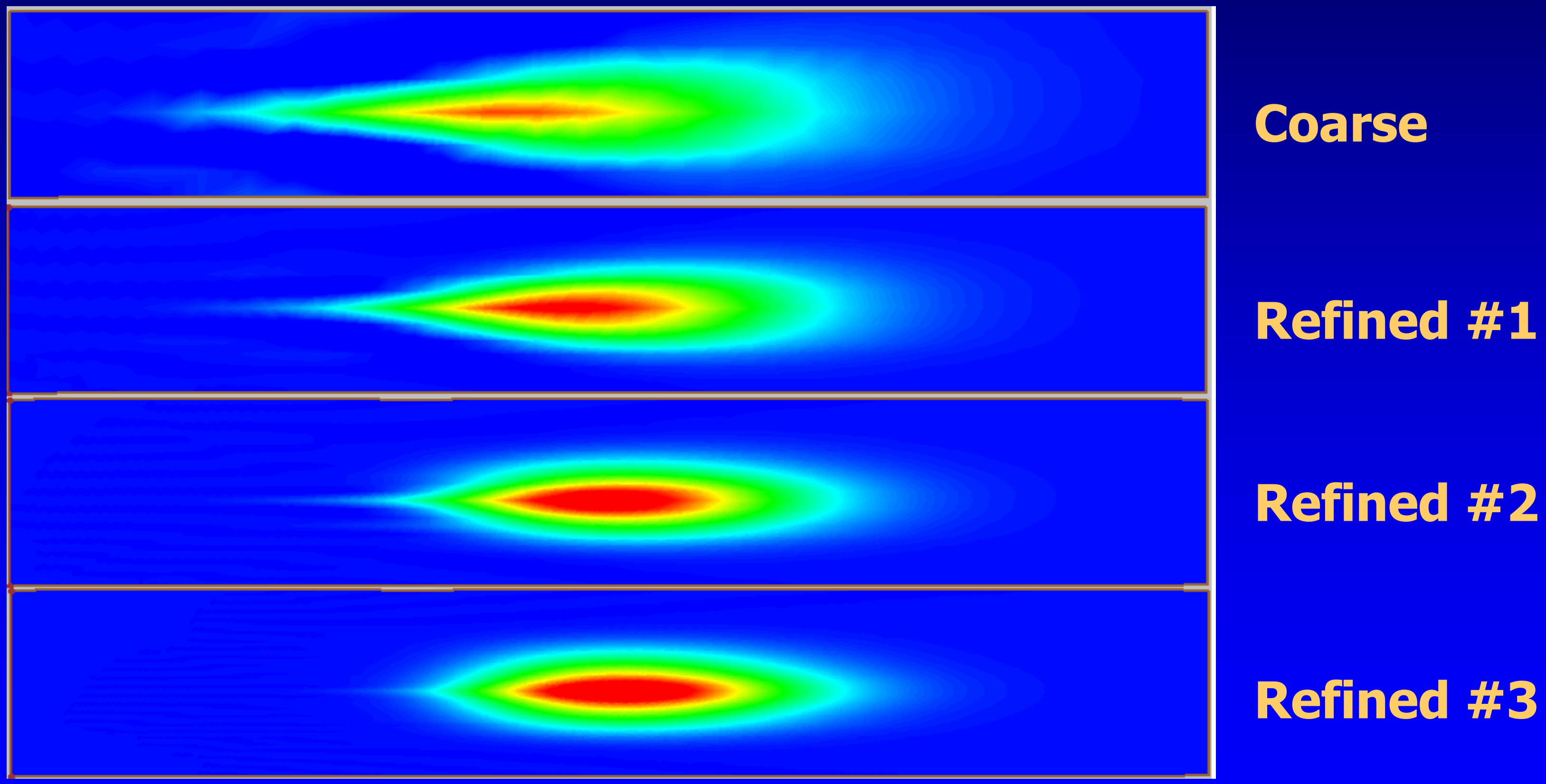
Refined Mesh #2
2525 nodes/4800 elements

Refined Mesh #3
9849 nodes/19200 elements



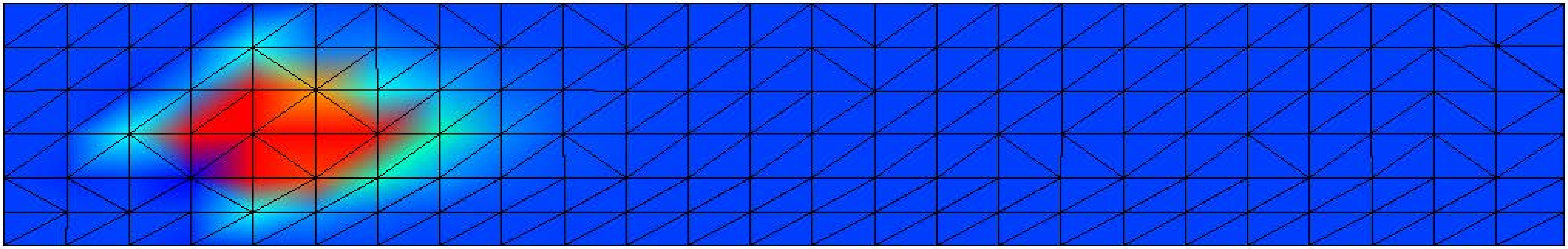
Initial Concentration Cloud

Grid Resolution Results…



at timestep = 380 seconds

Adaptive Mesh with Concentration Plume



US Army Corps
of Engineers

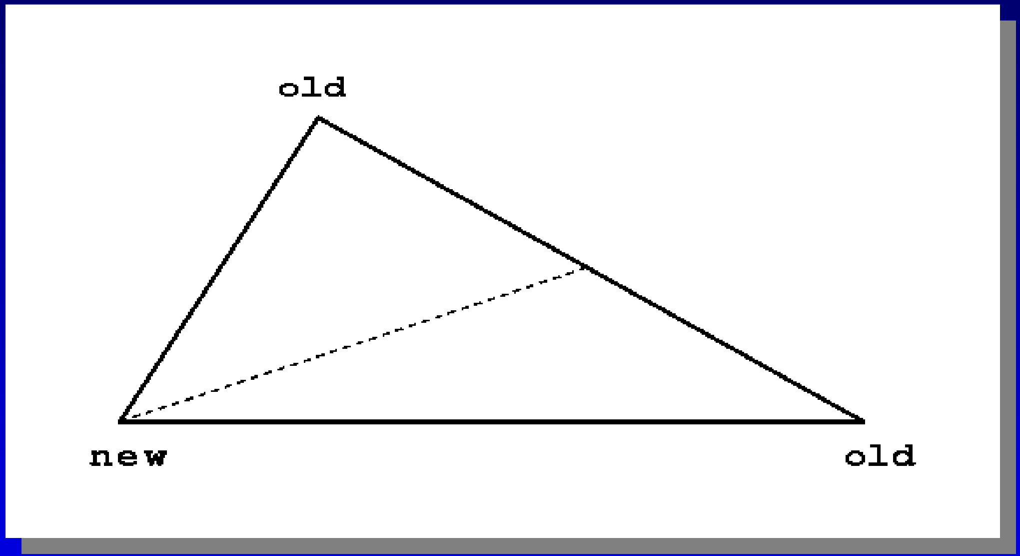
US Army Engineering R & D Center

Adaption Details

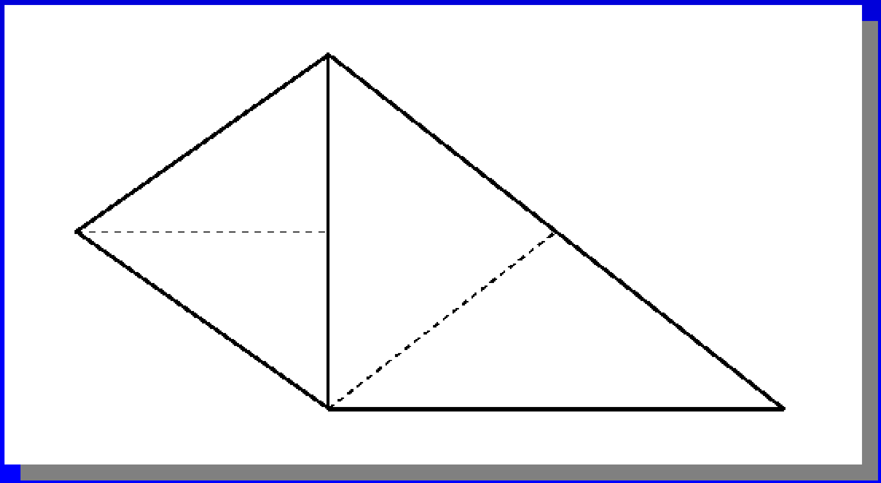
- Refinement
  - Error Indicator (conservation of mass)
  - Splitting Edges
  - Closure
- Coarsening
  - Finding duplicate elements

Modified Longest Edge Bisection

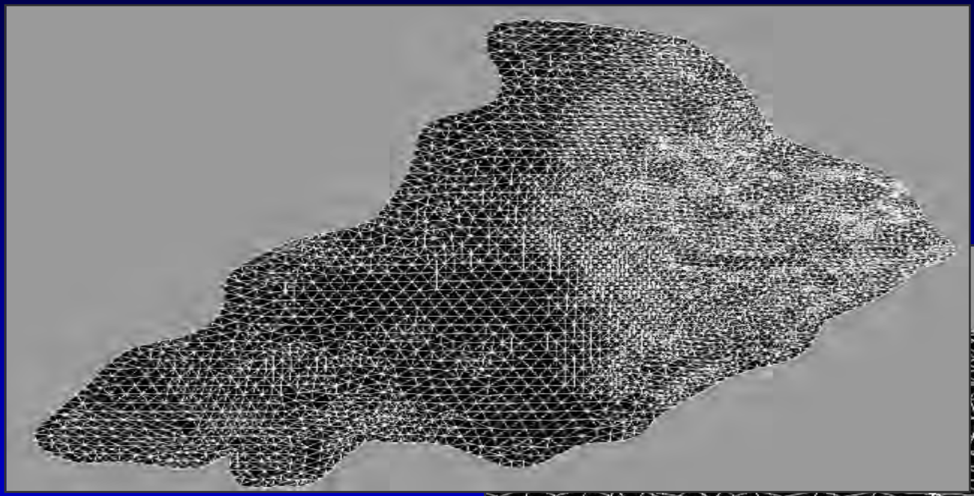
- Split oldest edge first.
- If edges are tied, then split the longest edge.

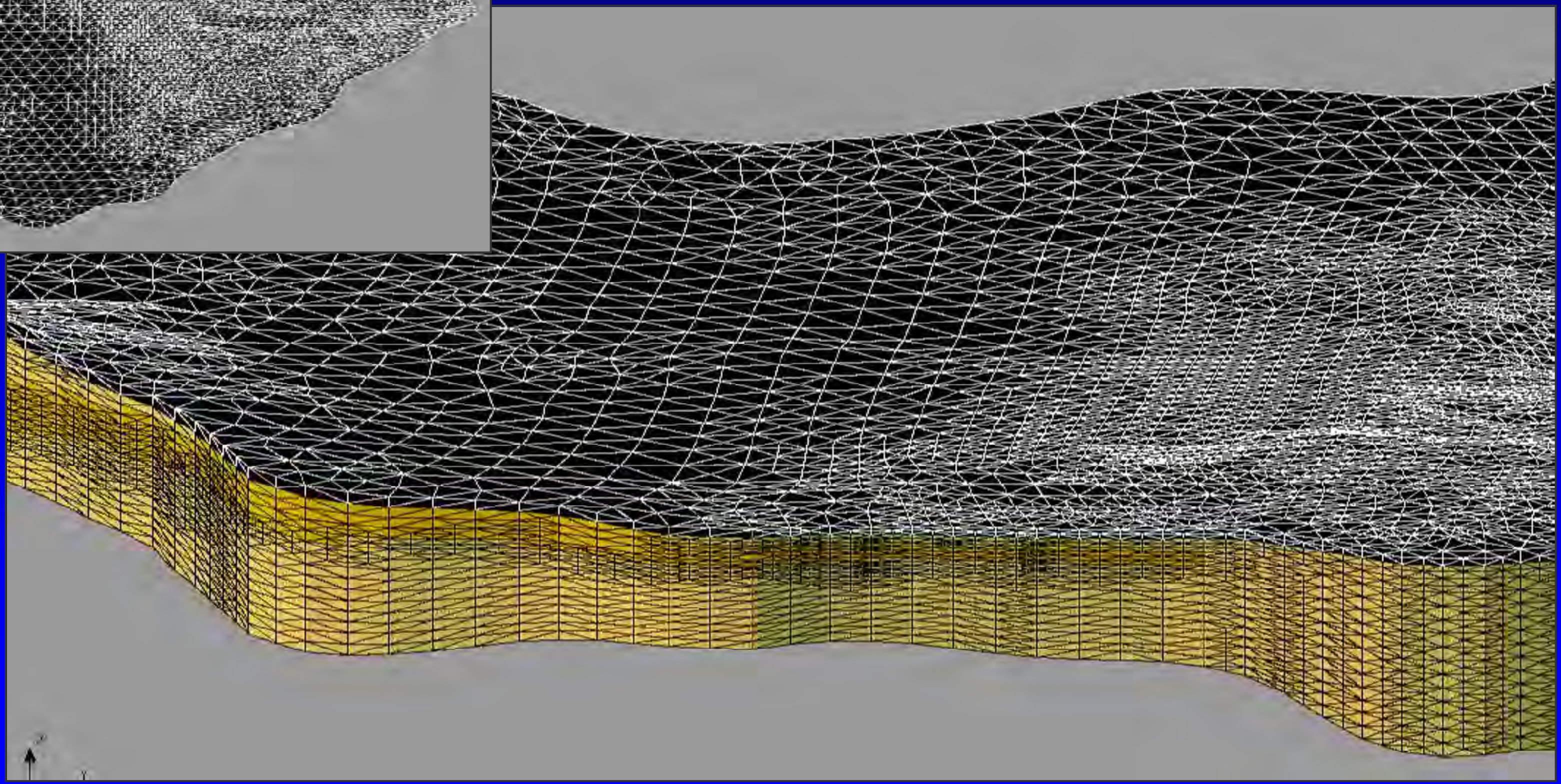


- Green closure required for non-conforming elements.

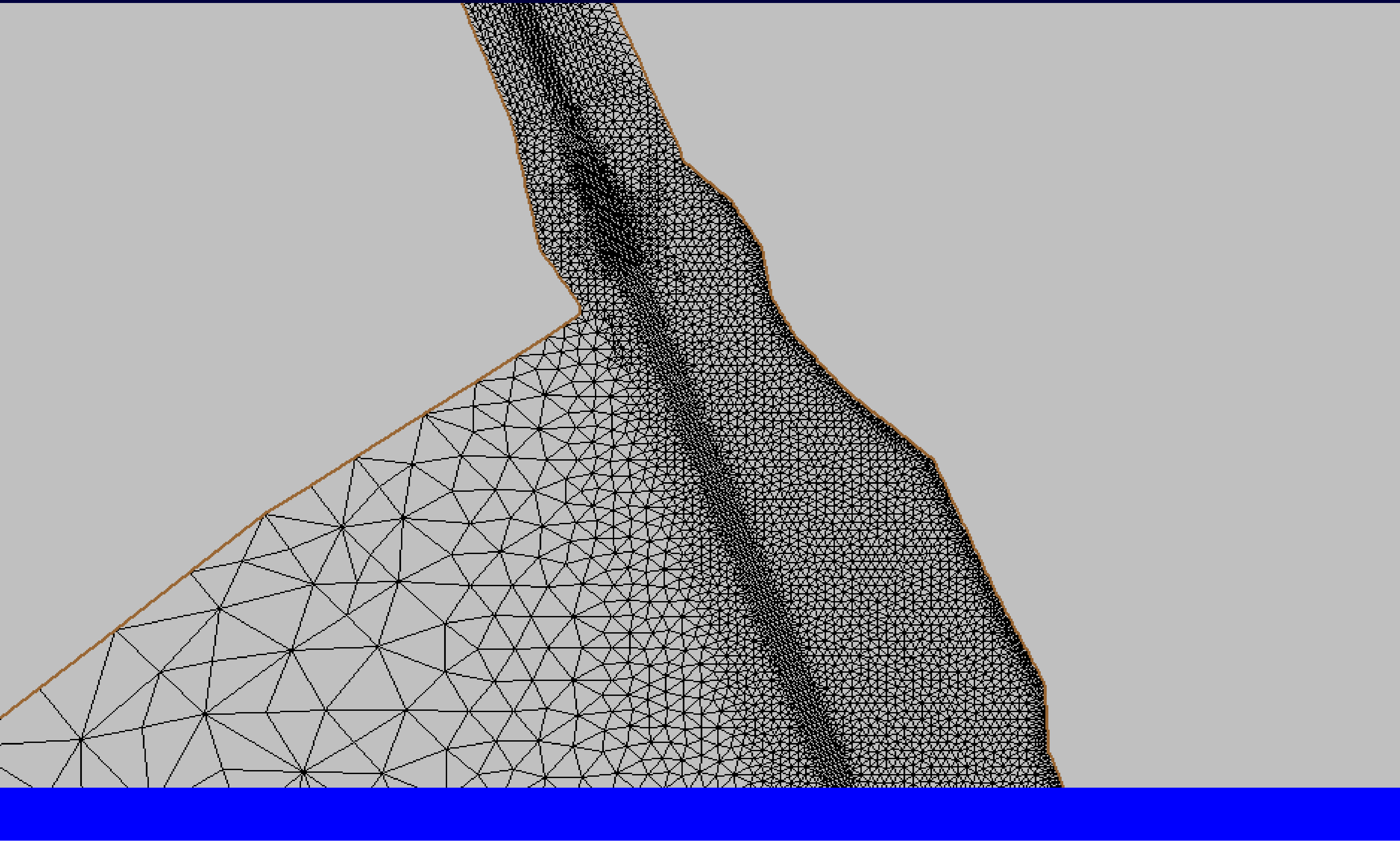


Mesh Adaption in the Subsurface

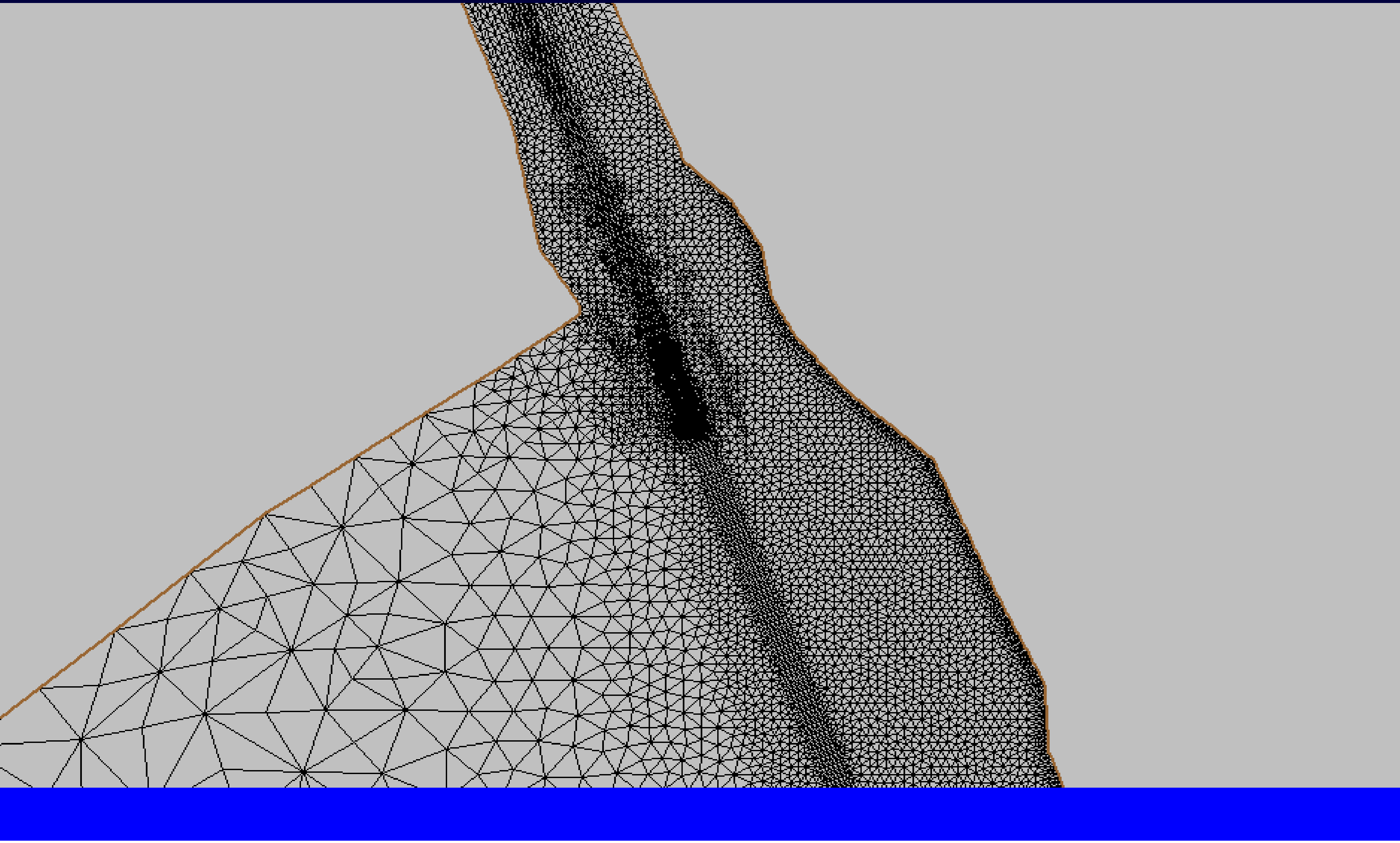




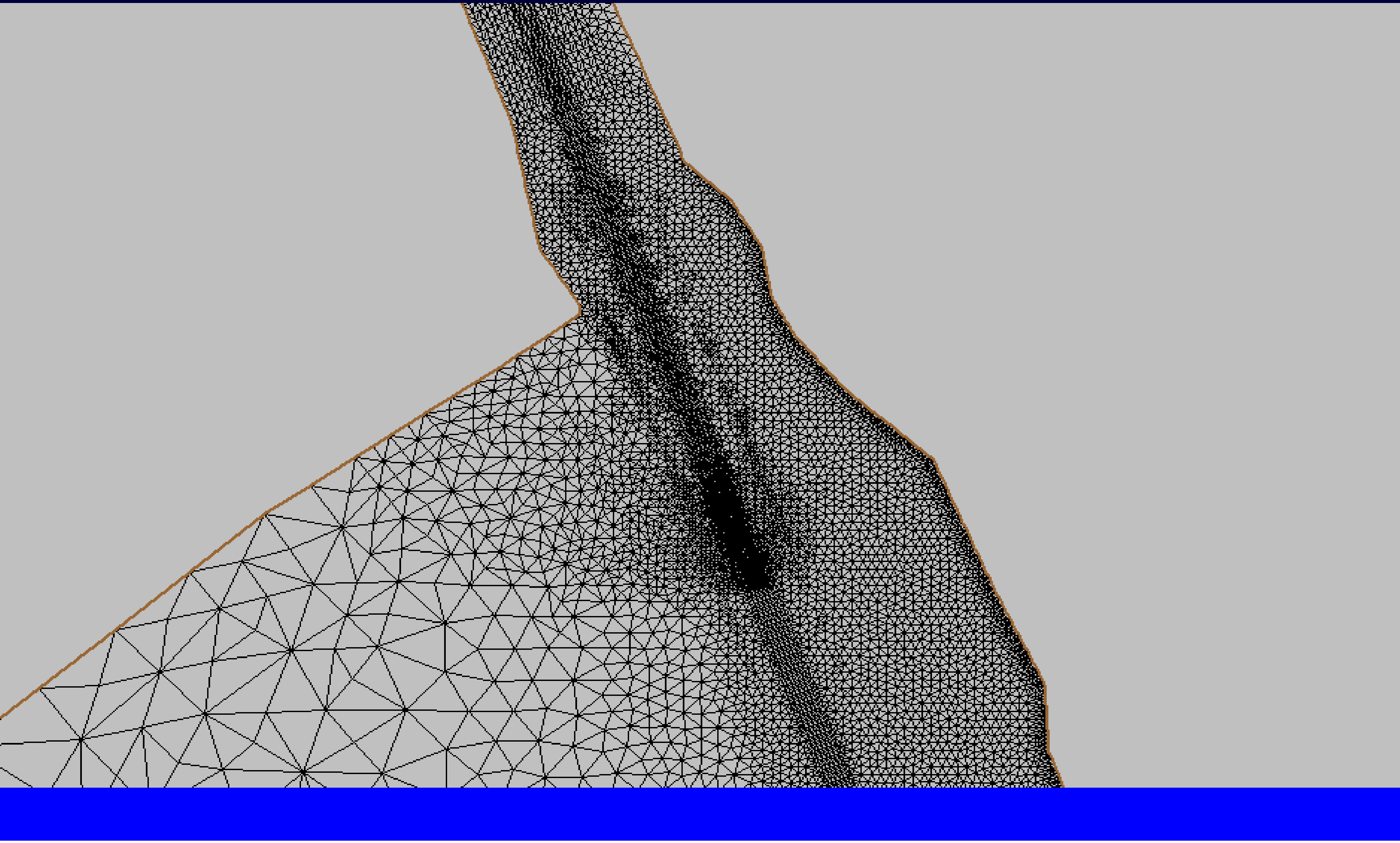
Adaption 1



Adaption 2



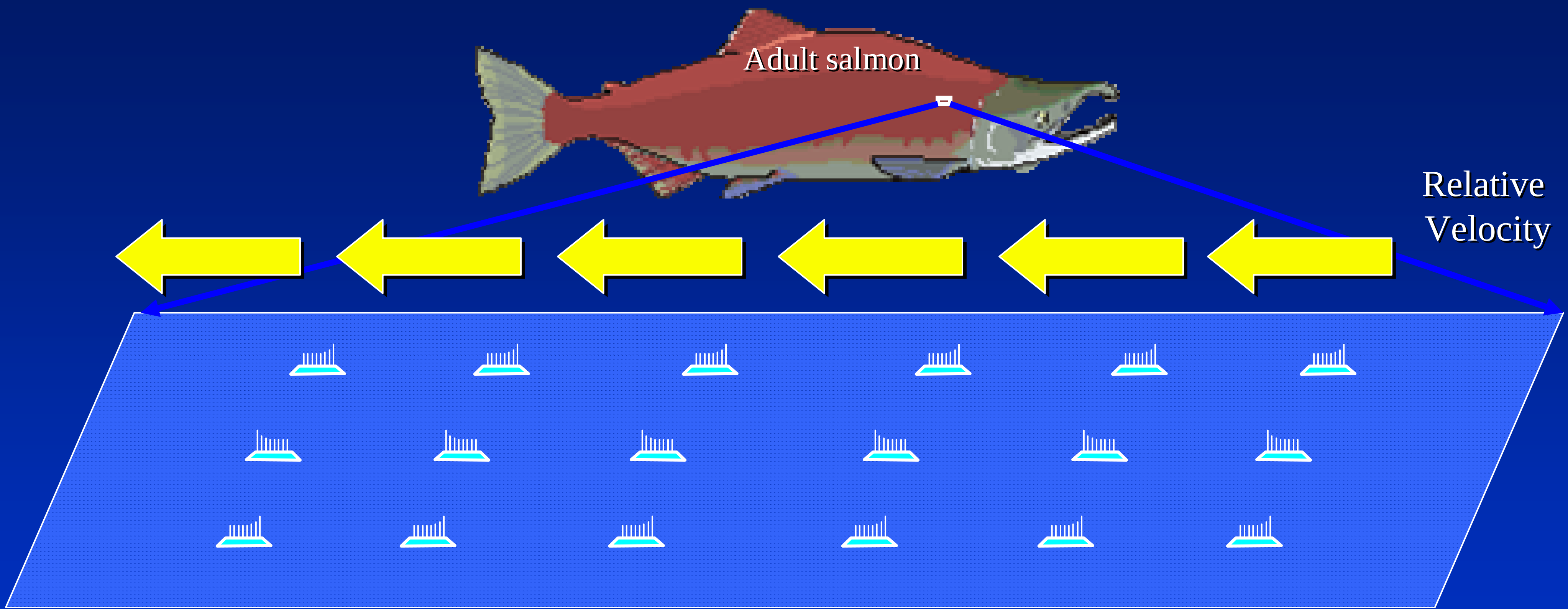
Adaption 3



Fish Behavior

Hydrodynamics from Fish's Point of View

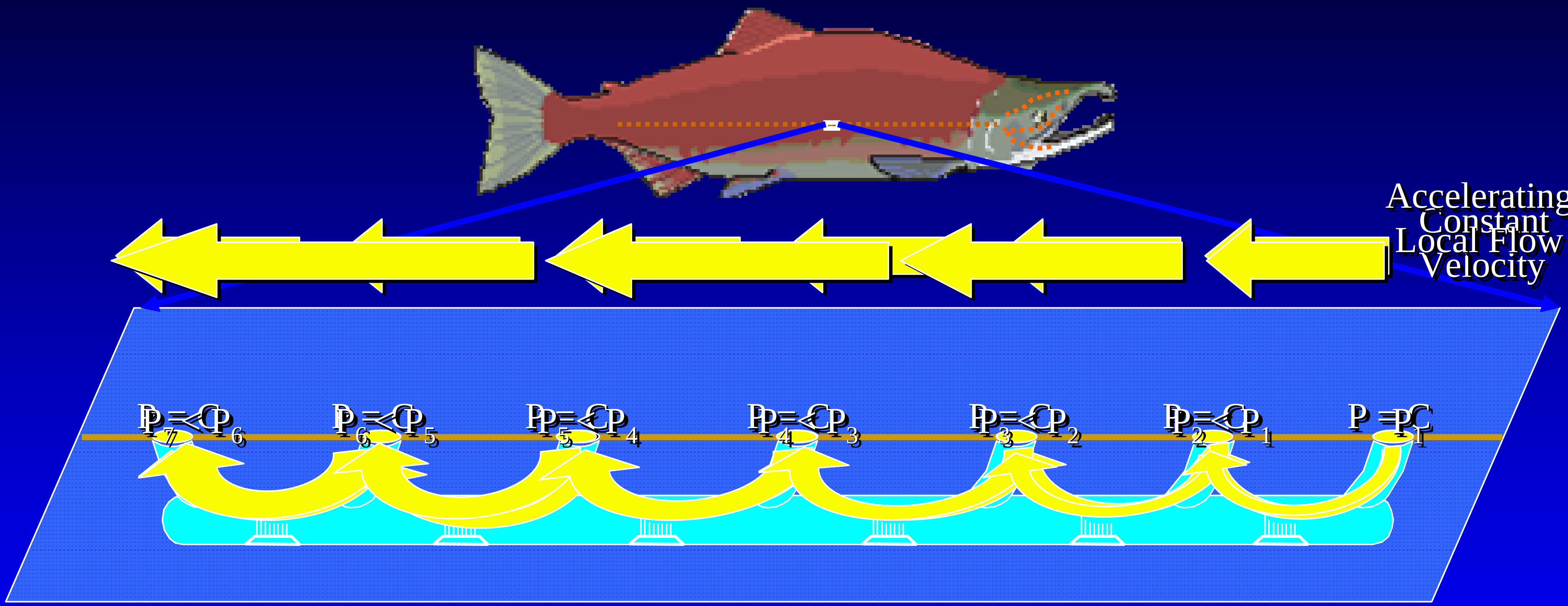
Mechanosensory System – Superficial Neuromasts



- Abundantly distributed spatially over the head and body of fish.
- Have the appropriate anatomical distribution and physiological properties to signal the strength and direction of flow.
- Have a preferred axis of sensitivity, or directional tuning, that would provide fish with the ability to detect current strength and direction at various positions on its body, enabling it to detect flow gradients or areas of current shear along its body.

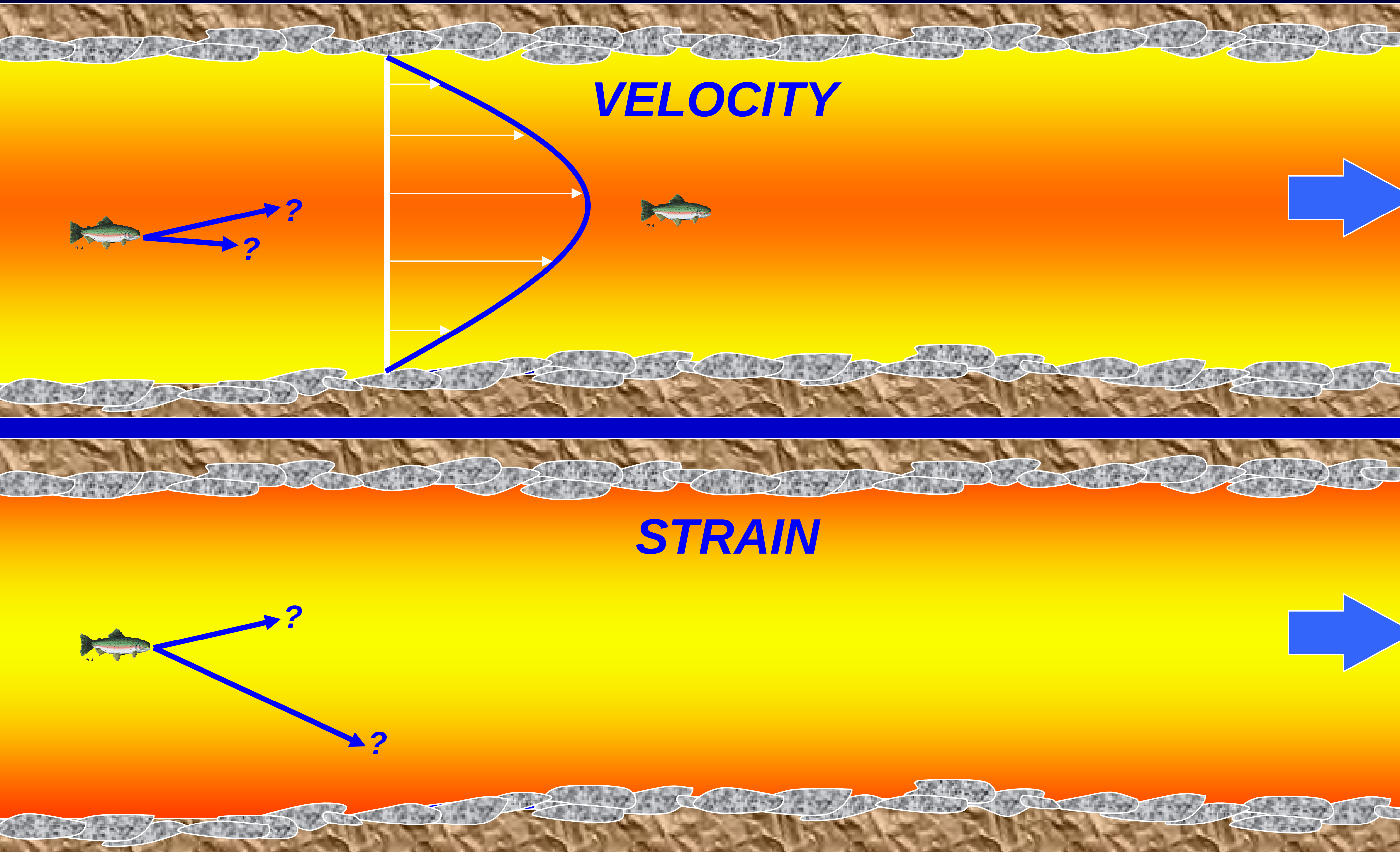
Hydrodynamics from Fish's Point of View

Mechanosensory System – Canal Neuromasts

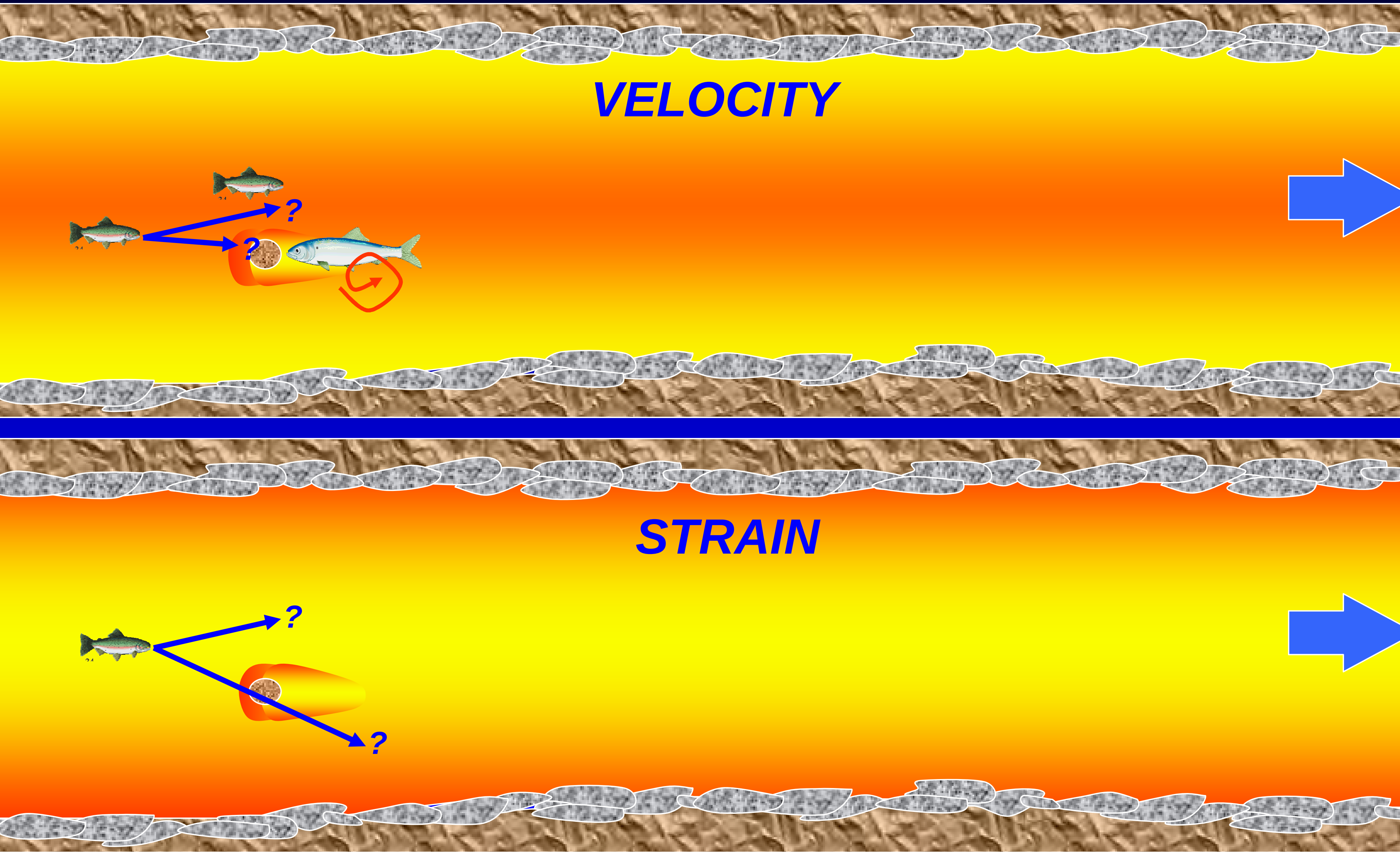


- Fluid accelerations vary greatly in strength and direction over very short distances close to a disturbance source, but provide the spatial nonuniformity the canal system is most sensitive to.
- Lateral line can be used to detect inanimate and stationary objects.
- Exposing the lateral, as opposed to frontal, portion of their 'lateral line' to disturbance sources provides fish with greater amount and breadth of information on the stimulus field.

Open River

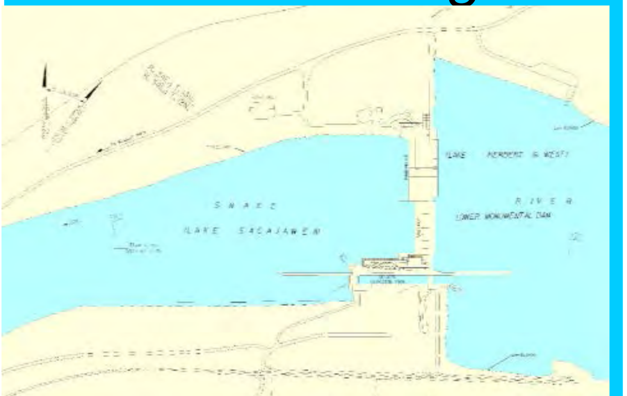


Obstacles in Open River

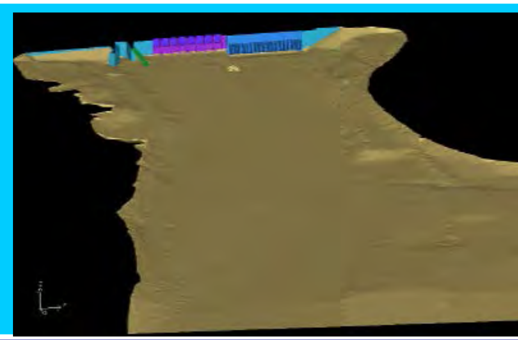


Modeling Process

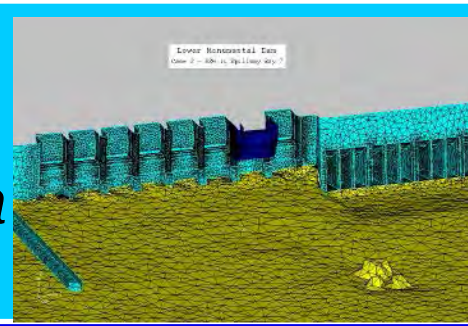
Line Drawings



CAD Surface Model



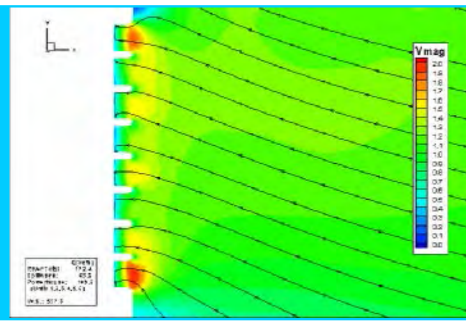
3D Mesh using Tetrahedra



Flow Solver (ADaptive Hydraulic Model)

Files: Geometry, B.C.'s, I.C.'s

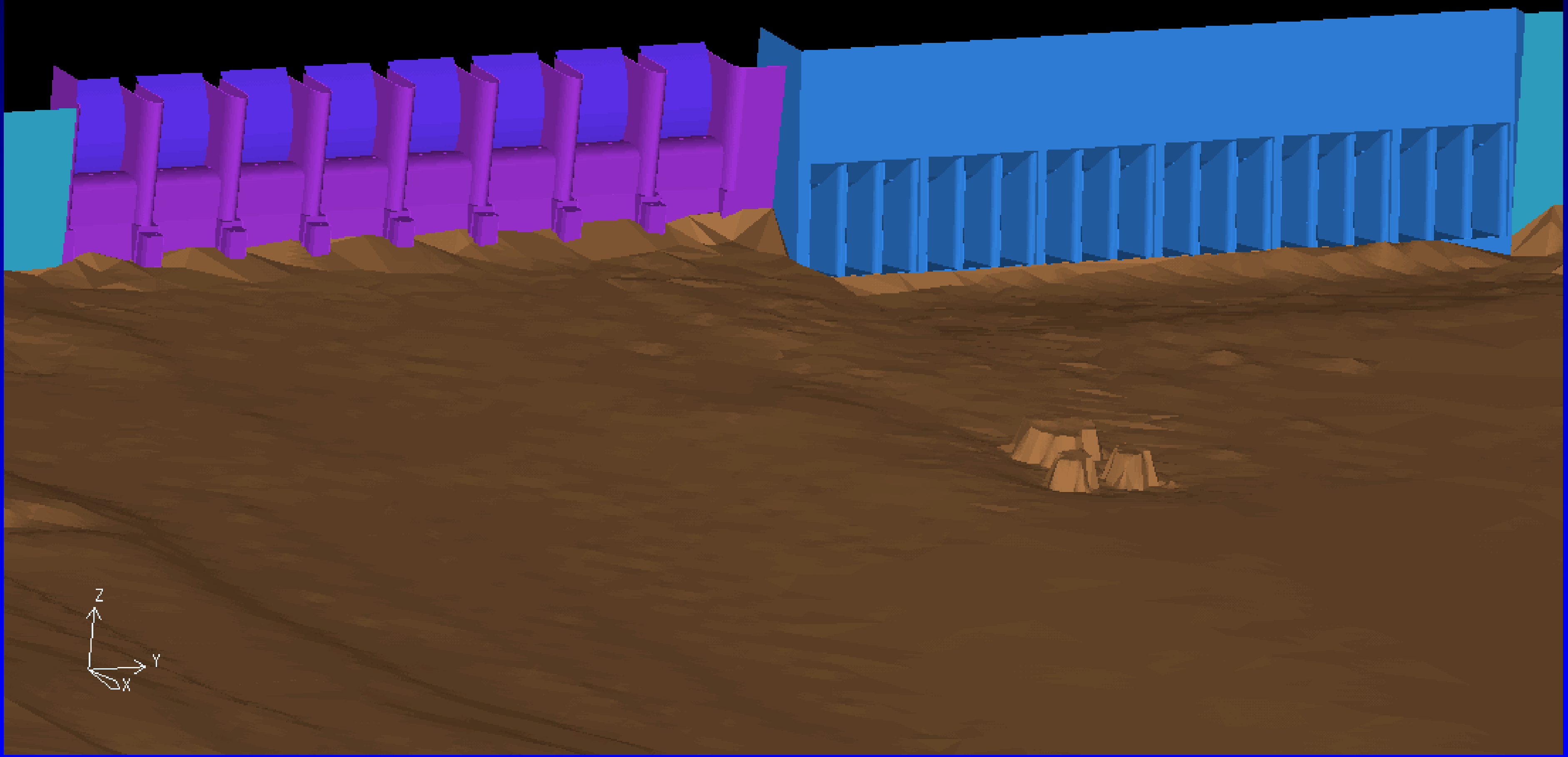
Post Processing (Visualization)



Lower Monumental Model

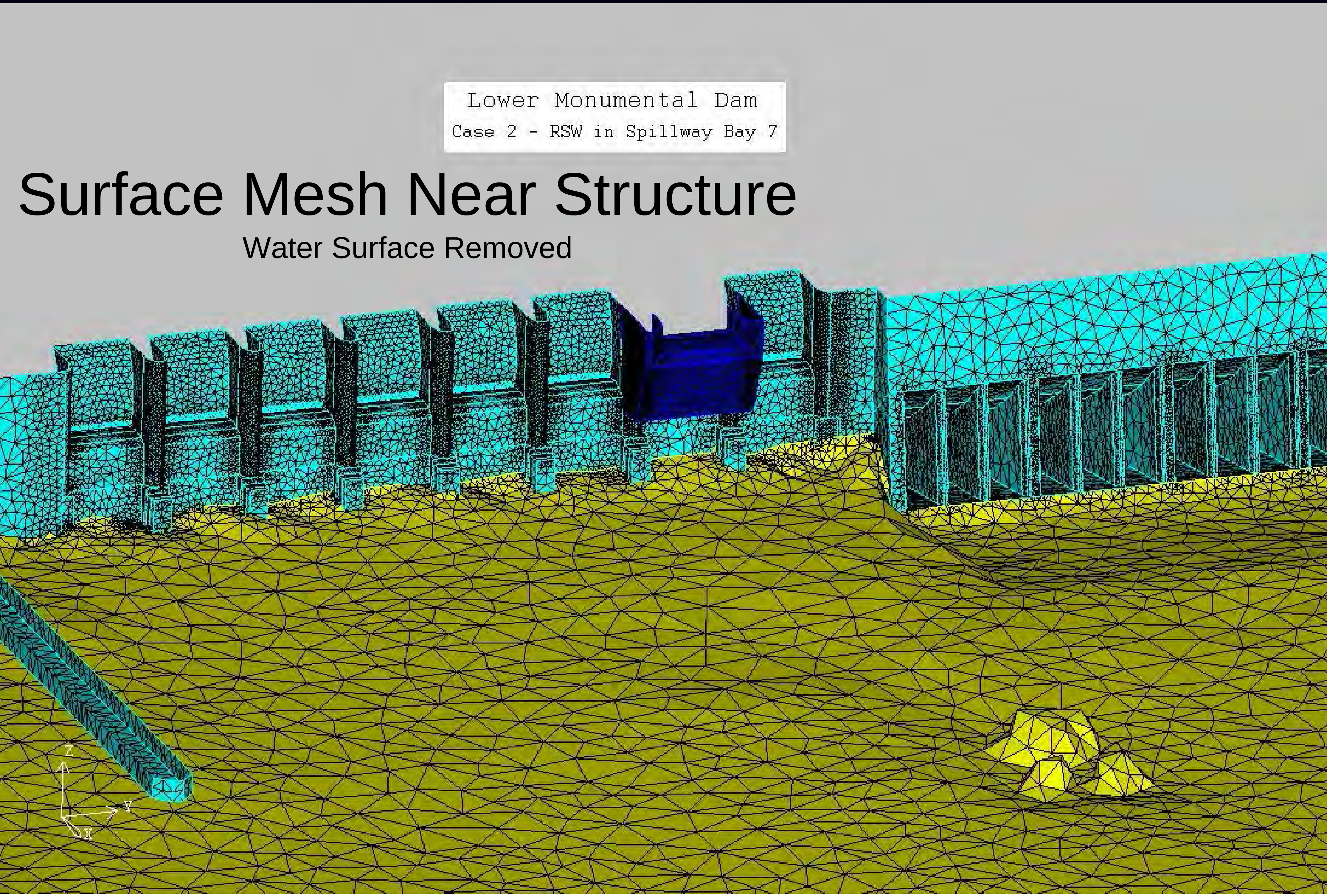
- 8100 ft of Snake River
- 3300 ft wide @ widest portion
- Structural Features: Lock Guard Wall, 8 Spillway Bays, & 6 Powerhouse Units

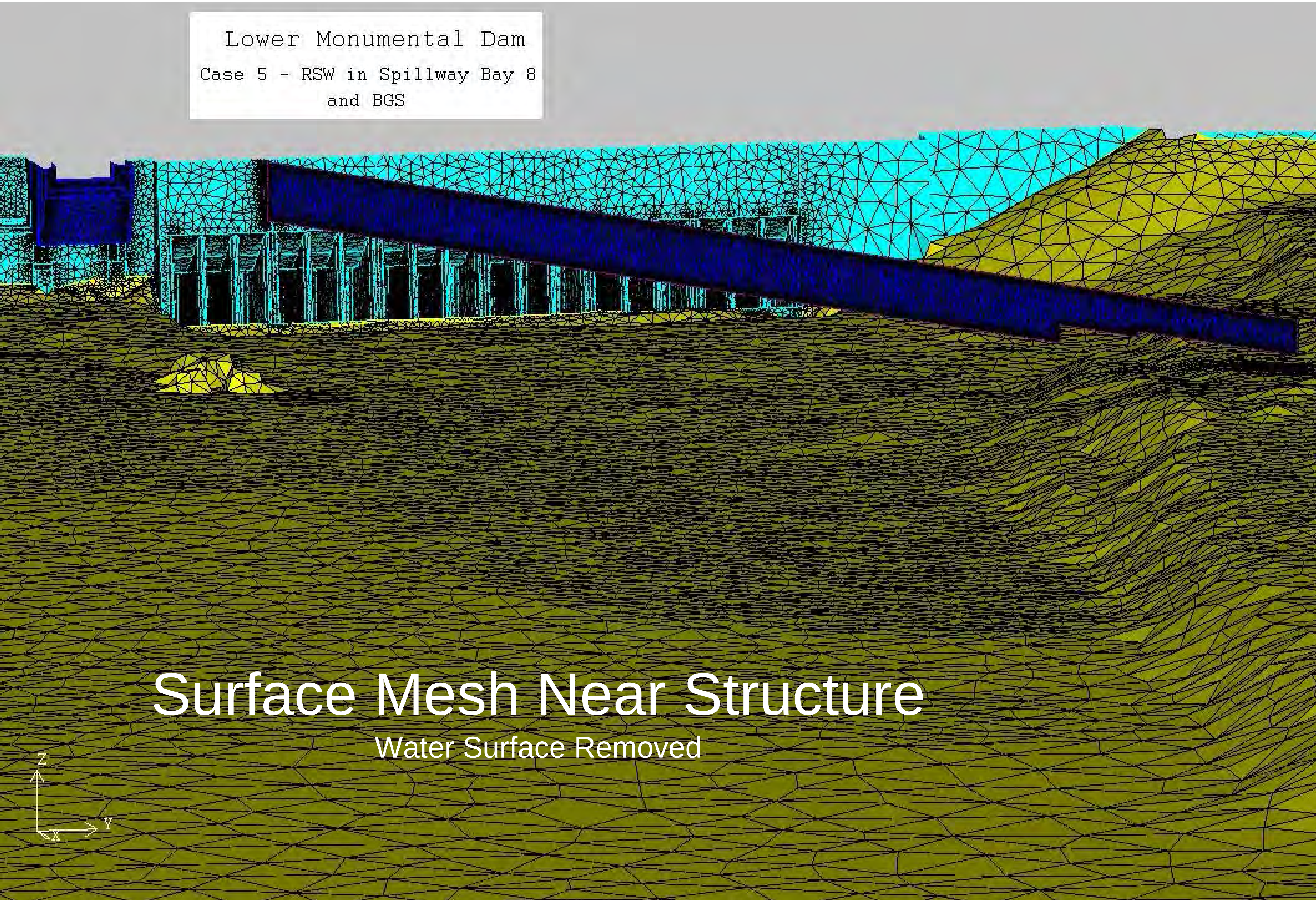
Details of Powerhouse and Spillway

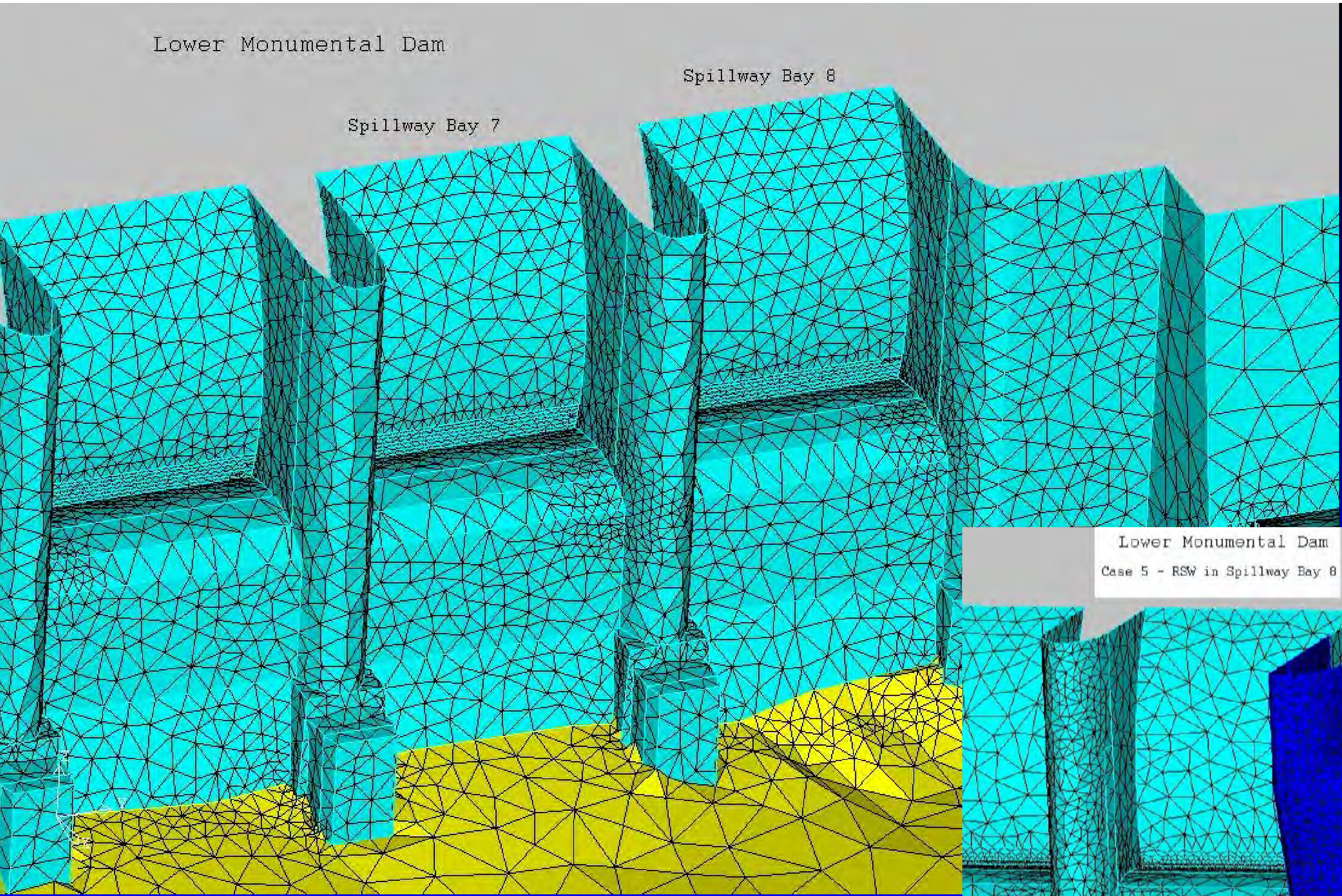


Surface Mesh Near Structure

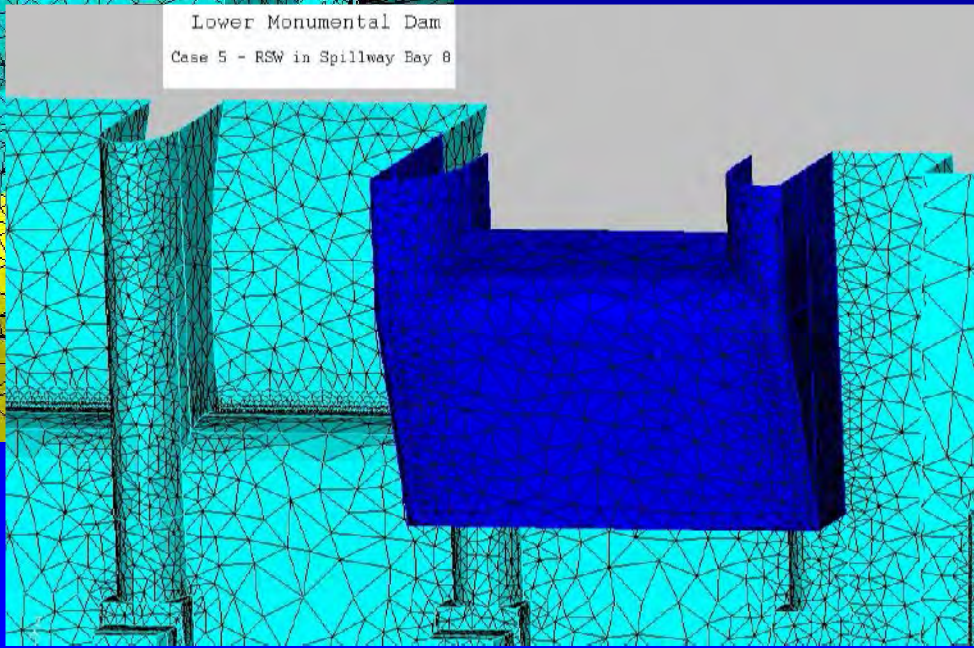
Water Surface Removed



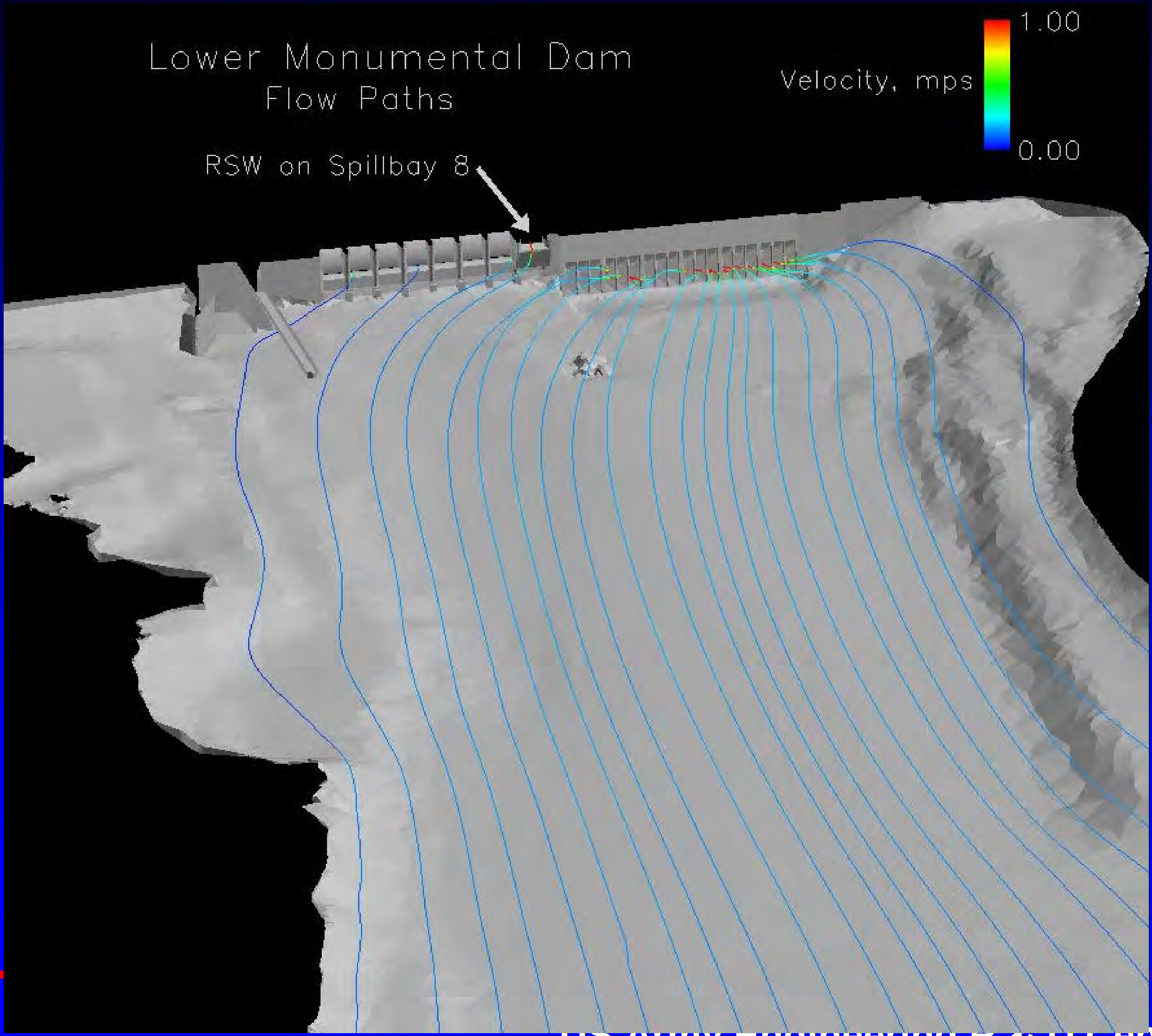

Lower Monumental Dam
Case 5 - RSW in Spillway Bay 8
and BGS
Surface Mesh Near Structure
Water Surface Removed
Z
Y
X

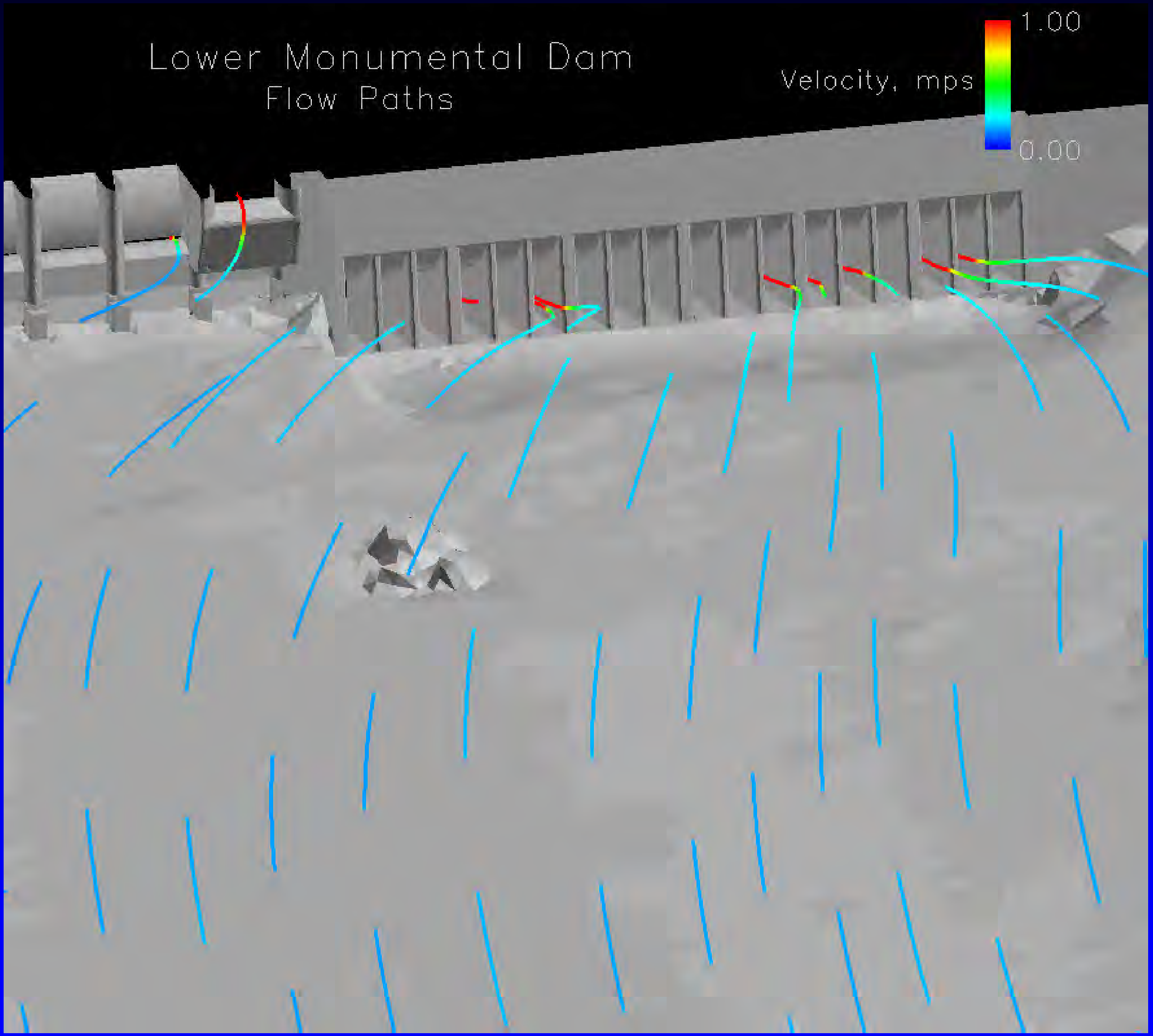


Lower Monumental Dam
Spillway Bay 8
Spillway Bay 7

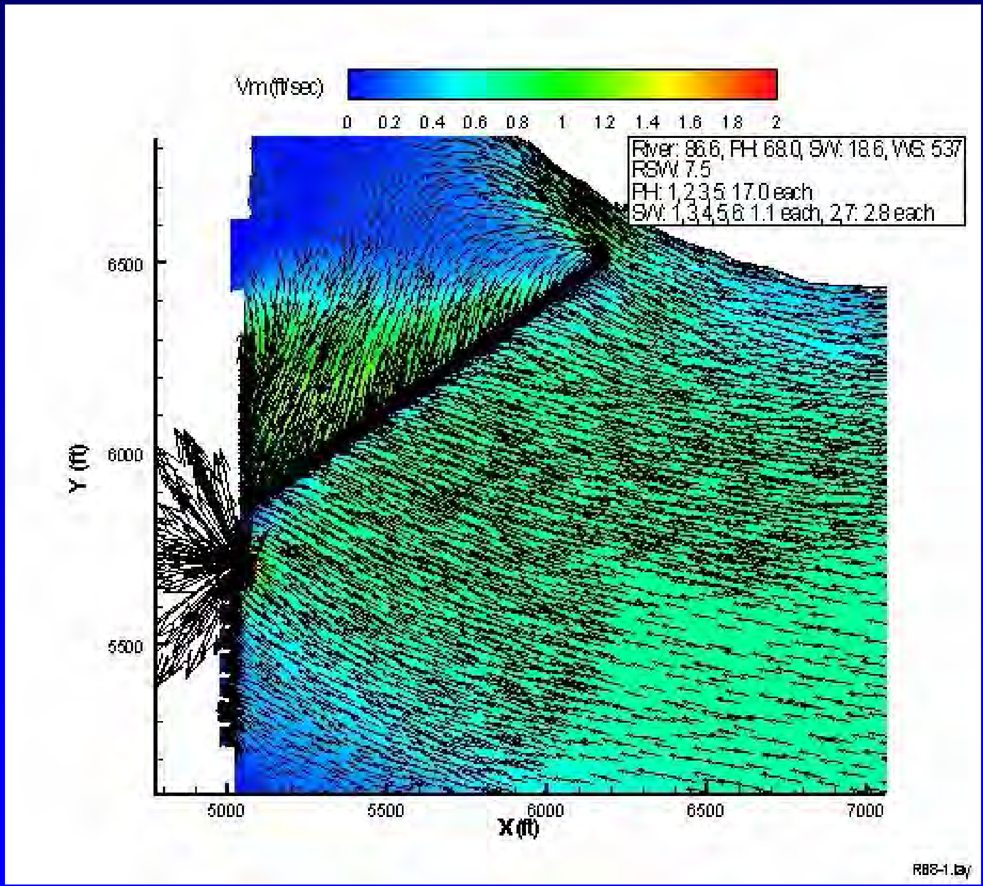


Lower Monumental Dam
Case 5 - RSW in Spillway Bay 8


Lower Monumental Dam
Flow Paths
RSW on Spillbay 8
Velocity, mps
1.00
0.00


Lower Monumental Dam
Flow Paths
Velocity, mps
1.00
0.00

Lower Monumental Reservoir Surface Currents



ADH_Navier-Stokes Solver Future Efforts

- Wind stresses: in PNW, setup sometimes drives surface currents upstream
- Unsteady flow patterns: at various time scales (e.g.unit operations, eddies, etc.)
- Capability to model contorted water surface (e.g. breaking waves, spillway flow, etc.)
- Incorporation of moving mechanical parts (bulkheads, gates, valves, etc.)

SYSTEM WIDE WATER RESOURCES PROGRAM
UNIFYING TECHNOLOGIES
GEOSPATIAL APPLICATIONS
(GIS IN SWWRP)

3 August 2005

2005 Tri-Service Infrastructure Systems Conference
"Re-Energizing Engineering Excellence"
The America's Center
St. Louis Convention Center
St. Louis, Missouri
2-4 August 2005

Andrew J. Bruzewicz, Director
Remote Sensing/GIS Center of Expertise
ERDC-CRREL
US Army Corps of Engineers
Hanover, New Hampshire 03755

TOPICS

- Geospatial R & D Program
  – Geospatial Program FOCs
- SWWRP Unifying Technologies – Geospatial Applications
  – Operating Principles
  – Approach
  – Summary of Geospatial Issues and Needs
  – Initial Activities and Products
- Discussion

GEOSPATIAL TECHNOLOGY AREA

Future Operating Capabilities

1. Capability to optimize data collection through :
   A corporate approach to SHARED GEOSPATIAL DATA that supports projected needs and ensures a high level of reliability.

2. Capability to provide new system components that allow:
   Efficient access of geospatial data at MULTIPLE SCALES.

3. Capability to offer: LINKED PROCESS MODELS that allow transparent flow of data between models.

4. Capability to provide: WEB MAPPING through Internet-enabled data access and analysis capabilities.

1) SHARED GEOSPATIAL DATA

Benefits

- Reduced duplication in data collection
- Fewer errors from inconsistent data sets
- More accurate data collection
- Reduced costs for project planning, design, operation and maintenance

Thrust areas

- Improved remote sensing, survey, and in-situ data collection methods
- Standardizing approaches to data development
- Expanded data collection through use of positioning systems
- Collection, inventory, and assessment of legacy data
- Integration of spatial data into existing Corps databases (NRMS, RAMS, REMIS)

2) DATA ACCESS AT MULTIPLE SCALES

Benefits

- **Accurate depiction of geospatial processes at regional scales**
- **Better capability to track cumulative impacts of regulatory actions**
- **Improved water allocation and emergency management strategies**

Thrust areas

- **Development of interoperable spatial data management system**
- **Develop technologies to depict geospatial data at multiple scales**
- **Integration of geospatial technology into Corps regional watershed, sediment, and ecosystem management models**

Data Access and Integration at Local and Regional Scales

3) LINKED PROCESS MODELS

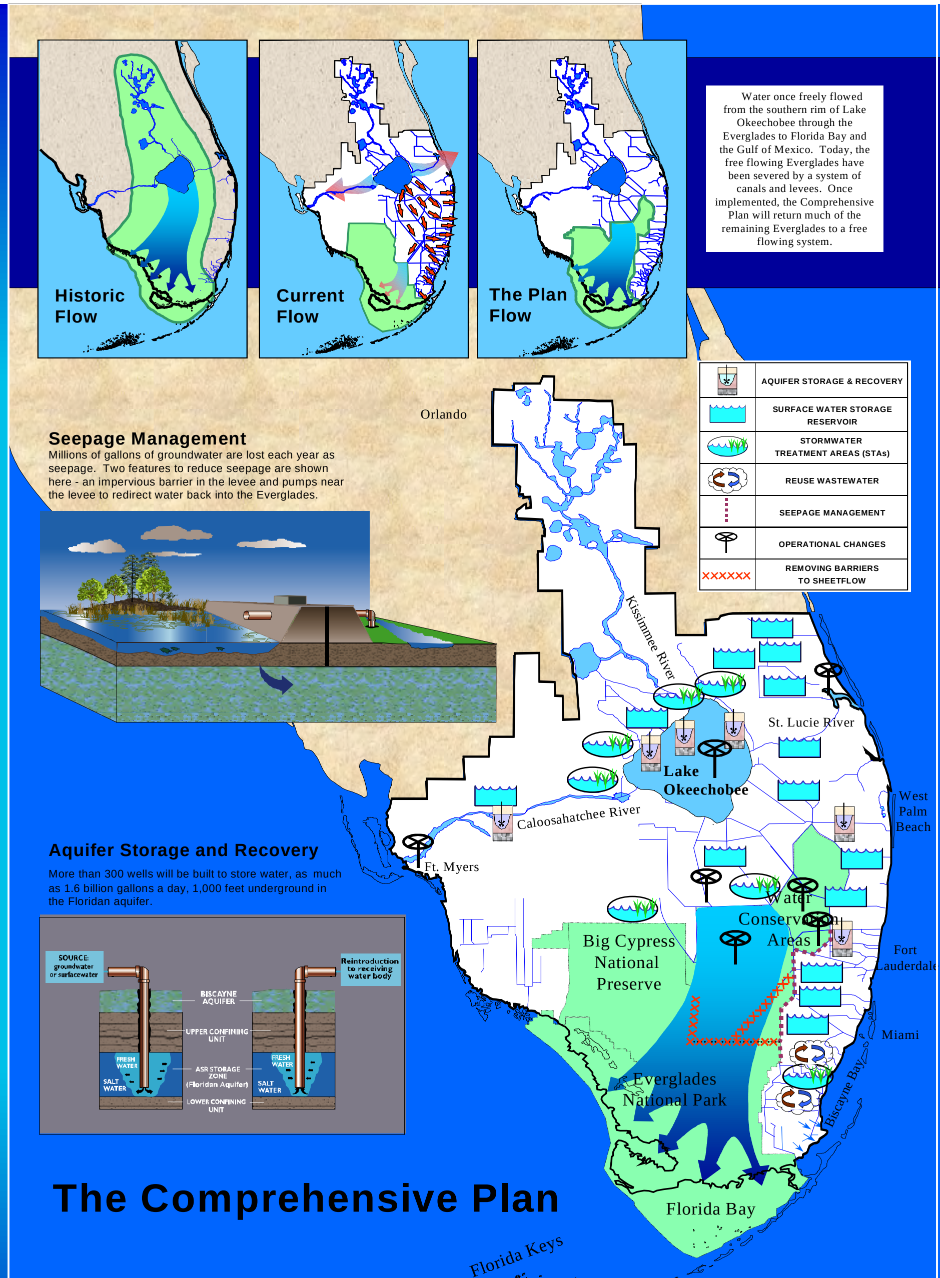
Benefits

- Increased model efficiency by providing transparent flow of data between models
- Improved decision support system through development of interoperable system
- Reduced costs for project planning, design, operation and maintenance

Thrust areas

- Transfer of geospatial data between various GIS and model hardware and software without user intervention
- Integrated GIS, GPS, RS, CADD data and systems
- Water supply and flood control
- Natural resource management

Linked Process Models



America's Everglades are in Serious Peril

4) WEB MAPPING

Benefits

- Improved decision support
- Better mapping, mission tracking, and hazards analysis in emergency operations.
- Improved flood damage and project benefit assessment
- Transparent access to necessary data on the Web

Thrust areas

- Internet-enabled data access and analysis
- Rapid mapping techniques
- Web Mapping Technology II
- Ecological and economic risk assessment technologies
- ??

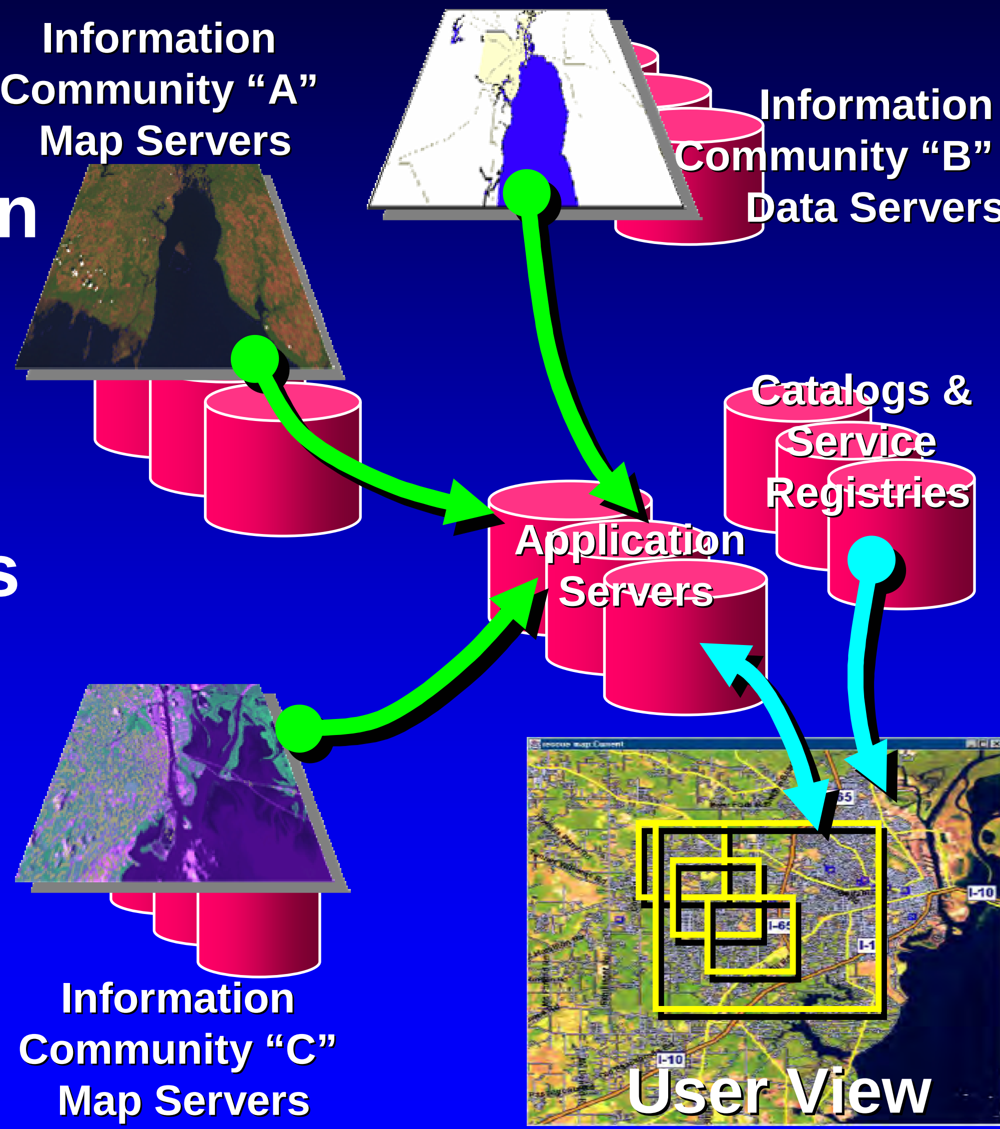
Web Mapping Technology

Discover, access and exploit online geodata from multiple information communities simultaneously using:

- web mapping client

- internet/intranet access

- industry specifications for interoperability.



SWWRP GEOSPATIAL APPLICATIONS AREA

KEY:

To support the development of watershed/water resource management systems through the integration of geospatial strategies, techniques, tools, and database structures for improved analysis, understanding, and decision support.

SWWRP GEOSPATIAL APPLICATIONS AREA

MAJOR GOALS:

1) Geospatially enabled models from the SWWRP pillars.

2) Integrated modeling environment enhanced by shared geospatial data and distributed and collaborative geospatial tools.

3) Seamless data flow.

SWWRP GEOSPATIAL APPLICATIONS AREA

MAJOR GOALS:

4) Improved applications, analysis, display, and decision support through appropriate use of geospatial technologies.

5) A geospatially enabled system permitting evaluation of the probability of success of an action and evaluation of alternatives

SWWRP GEOSPATIAL APPLICATIONS AREA

OBJECTIVE:

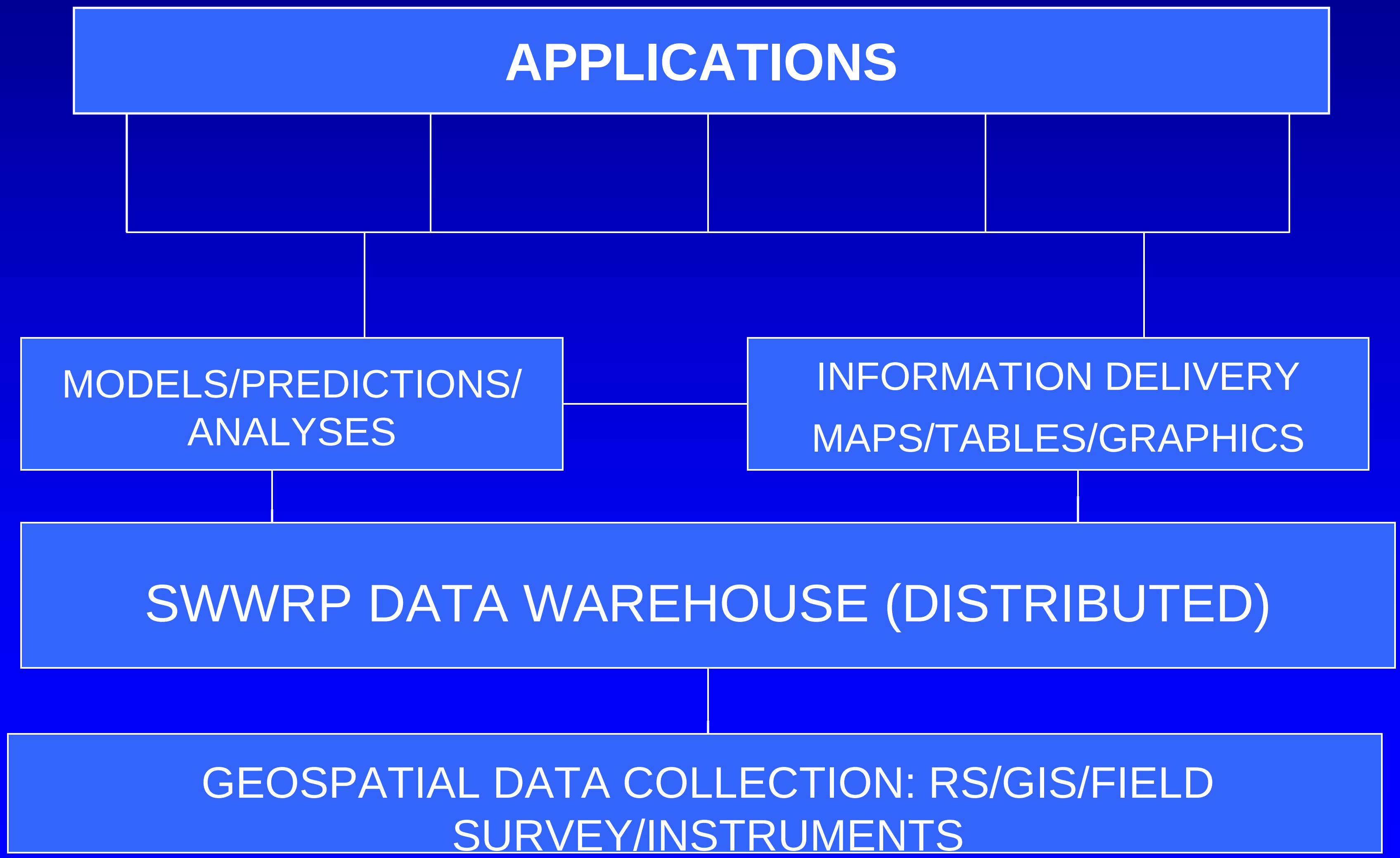
To meet both modelers and end-users requirements for effective display of model results, geospatial analysis and integration and use of geospatial data in the SWWRP.

SWWRP GEOSPATIAL APPLICATIONS AREA

STRATEGY:

- Needs-based approach predicated upon modelers and end-user requirements
- Significant leveraging of existing enterprise programs and Automated Information Systems
- Open ongoing dialog with related business program requirements

SWWRP GEOSPATIAL DATA



GEOSPATIAL ISSUES AND NEEDS

- Geospatial enabling of select models
- Scalability
  - Micro- and meso-scale understanding do not necessarily scale up
  - Representation
  - Data access
- Web Mapping
- Uncertainty
- Characterization
- Common look and feel
- Linked process models
  - Input/Output

Arkansas River Capability Demonstration

- Problem:
  - Methodology for collecting geologic, geomorphic, and structural data at a project location is well-defined using data sheets
  - Currently data assimilation and processing is time-consuming and labor intensive
  - Spatial data are not easily incorporated with other data
  - Digital spatial data are not readily available in the field to assist with data collection and verification
  - Data in a spatial context

Arkansas River Capability Demonstration

- **Project Scope:**

  Development of a suite of tools to identify and analyze geomorphology in the river and to evaluate geomorphology with riverine habitats and fish communities.

- **Needs include:**
  - **Ability to differentiate between sand and gravel deposits without detailed sampling**
  - **Development of a habitat suitability index for river channels that includes:**
    - **Topography**
    - **Soils**
    - **Aquatic vegetation**
    - **Substrate variability**
    - **Water depth**
    - **Important/sensitive species**

Arkansas River Capability Demonstration

Approach:

- Phase 1: Tool for automating field data collection and location information
  - ArcPad
- Phase 2: Methodology for storing data back at the office
- Phase 3: Utility for processing and analyzing field data in a spatial context
  - ArcGIS 9 extension

Statistical Methods for Water Resources Engineering

- Objective: To combine current and new statistical techniques with the regional analysis capabilities available in GIS software to provide improved knowledge of the risk associated with floods, low flow periods, and drought.

The statistical methods analytical engine will be loosely coupled with ArcGIS and data will be retrievable using the ArcHydro data model.

Statistical Methods for Water Resources Engineering

- Intermediate Products: Risk estimates and uncertainty measures for:
  - Flood, high flow, and low flow analysis
  - Environmental concerns related to best management practices and ecosystem restoration
  - Drought analysis and water supply planning

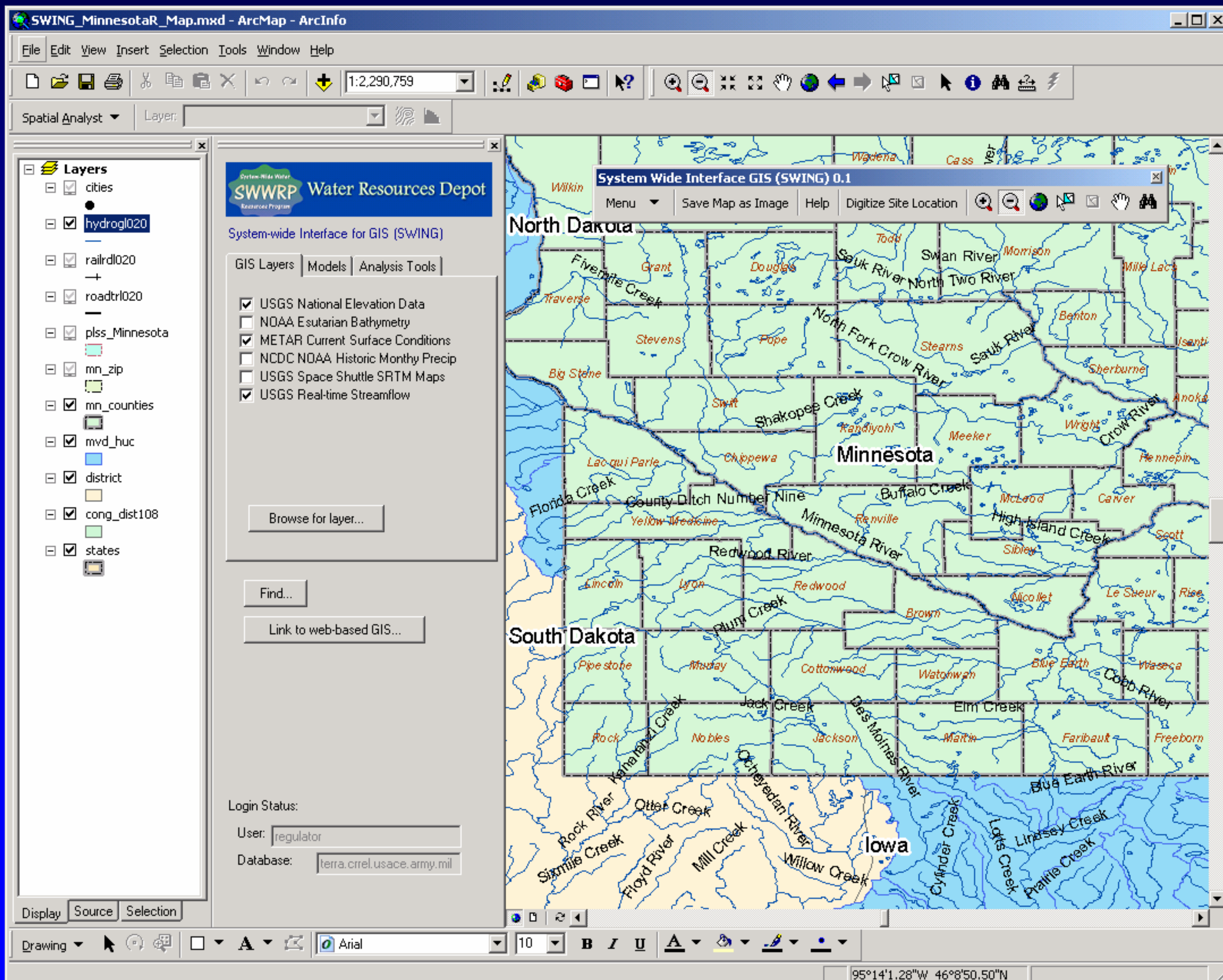
Onondaga Lake Capability Demonstration

- **Objective: Develop guidance on data required for basic watershed studies and an ArcGIS extension to identify useful analyses with pointers to appropriate data types at appropriate scales. The tool will address the effects of scale and resolution as they relate to specific models and analyses at the site scale and basin/sub-basin scales.**

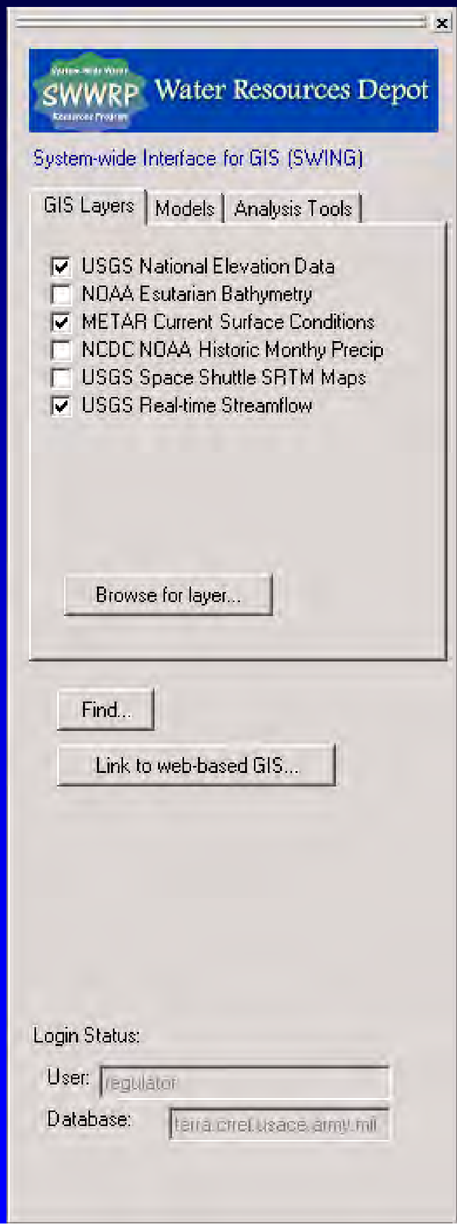
System-Wide Interface GIS (SWING) for the System-Wide Water Resources Program: Minnesota River Basin Capability Demonstration

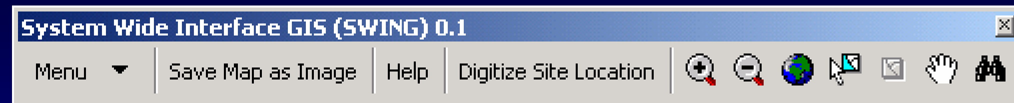
- **Task: Create a GIS-enabled Extension for SWWRP projects to leverage existing geospatial data, models and analysis techniques.**
- **Solution: An Extension for ArcGIS 9.1 with access to centralized GIS and database tables.**

System-Wide Interface for GIS (SWING)
Minnesota River Basin Capability Demonstration



System-Wide Interface for GIS (SWING) Minnesota River Basin Capability Demonstration





Existing GIS data layers and SWING tools can be used to automatically fill in spatial information such as coordinates, state, county, zip code, hydrologic unit code, township and range information.

Tools are flexible:

Users with little or no GIS training can quickly learn to use the tools and find and use SWWRP data layers, models and analysis tools.

GIS professionals can make use of SWWRP data dictionary, water resources models and analysis tools from within ArcGIS.

System-Wide Interface for GIS (SWING)
Minnesota River Basin Capability Demonstration

- **By creating an ArcGIS Extension for access to the SWWRP Data Dictionary, Models and Applications, Corps of Engineers personnel will have access to local and centralized multi-agency GIS data layers in order to streamline the work efforts of Water Resources Projects.**

SWWRP GEOSPATIAL APPLICATIONS

QUESTIONS???

BACKUP SLIDES

SWWRP Unifying Technologies Geospatial Applications - Products

- Identification of methodologies, models, and algorithms (MMAs) being used by or planned for SWWRP that require geospatial implementation
- Develop structure of SWWRP GIS capabilities
- Develop an ARCIMS web mapping interface to the SWWRP data engine
- Integration of GIS with data and models
- Integration of GIS with Decision Support Systems (DSSs)
- Identification of geospatial uncertainty requirements of SWWRP and geospatial solutions

Unifying Technologies – Geospatial Applications

• Collect requirements for geospatial MMAs from Regional Water Management, Regional Sediment Management, and Ecosystem Assessment Modeling pillar focus area leaders
• Collect requirements for geospatial MMAs from other business areas: navigation, flood and coastal storm damage reduction, hydropower, regulatory, environment, emergency management, recreation, water supply, and work for others
• Assess approaches to development of the structure of SWWRP GIS capabilities based upon programmatic needs and lessons learned in Corps enterprise GIS toolsets (CorpsMap, ENGLink, CorpsVIew, and MSC approaches [e.g., MVD, SAD])

Unifying Technologies – Geospatial Applications
Requirements Collection Leading to a Design Manual- The Approach

- Identification of protocols being used within and outside USACE available to connect system-wide components
- Selection of prototype system environment (possibly CWMS or XMS)
- Design document for geospatial applications

Advances to the GSSHA model

Aaron Byrd
Cary Talbot
ERDC-CHL

System-Wide Water Resources Program (SWWRP)

- **7-year USACE R&D initiative designed to assemble and integrate the diverse components of water resources management**
- **The ultimate goal is to provide to the Corps, its partners, and stakeholders the overall technological framework and analytical tools to restore and manage water resources and balance human development activities with natural system requirements**

https://swwrp.usace.army.mil

SWWRP Program Structure

USACE/National Water Resource Needs

Regional Water Management

- Watershed Hydrology Simulation
- Riverine & Estuarine Simulation
- Coastal Simulation
- Water Processes & Assessments

Regional Sediment Management

- River Basin Morphology, Modeling, & Management
- Coastal Morphology, Modeling, & Management
- Sediment Management Methods
- Sediment Processes Studies

Ecosystem Assessment & Management

- Landscape Assessment
- Transport Modeling
- Ecological Modeling
- Ecosystem Response Forecasting
- Ecosystem Processes

Unifying Technologies

- Integrating Frameworks
- Data Management
- Geospatial Applications Development
- Regional Measurement and Monitoring
- Model Integration
- Decision Support and Knowledge Management

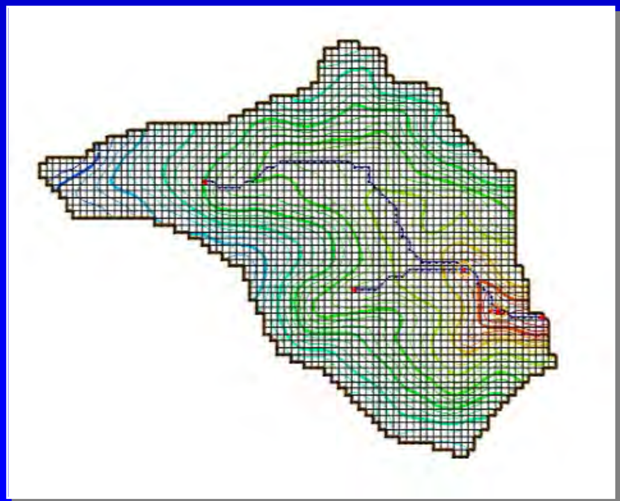
Corps Business Lines

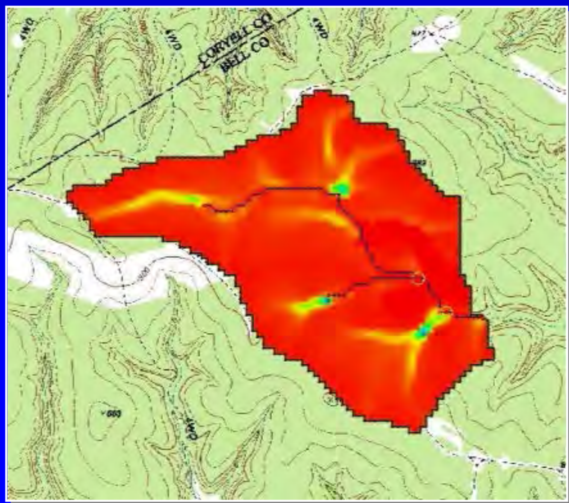
SWWRP
Watershed Hydrology Simulation

- 5 Research Areas
  - HMS development
  - GSSHA development
  - Uncertainty/parameter estimation/stochastic simulation tools for system-scale models
  - Regional flood prediction
  - Coupled, multi-dimensional groundwater-surface water interaction simulation

GSSHA

- Distributed, physically-based Gridded Surface Subsurface Hydrological Analysis (GSSHA) model
- Simulates 2D overland flow, 1D channel routing, 2D saturated groundwater flow, canopy retention, microtopography, 1D infiltration and ET using finite-difference and finite-volume methods





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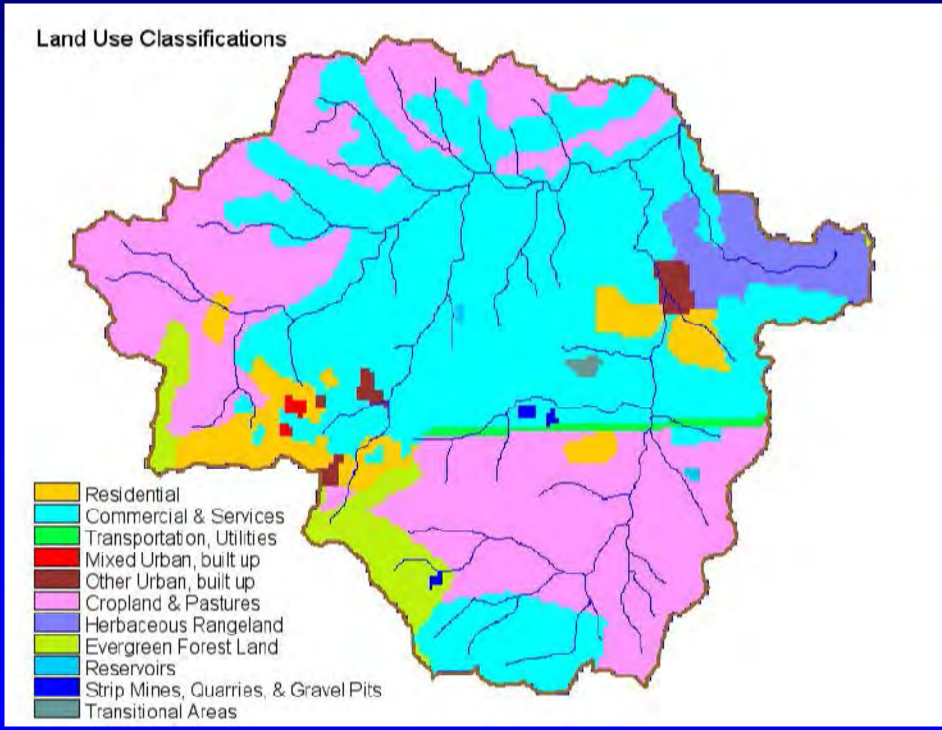
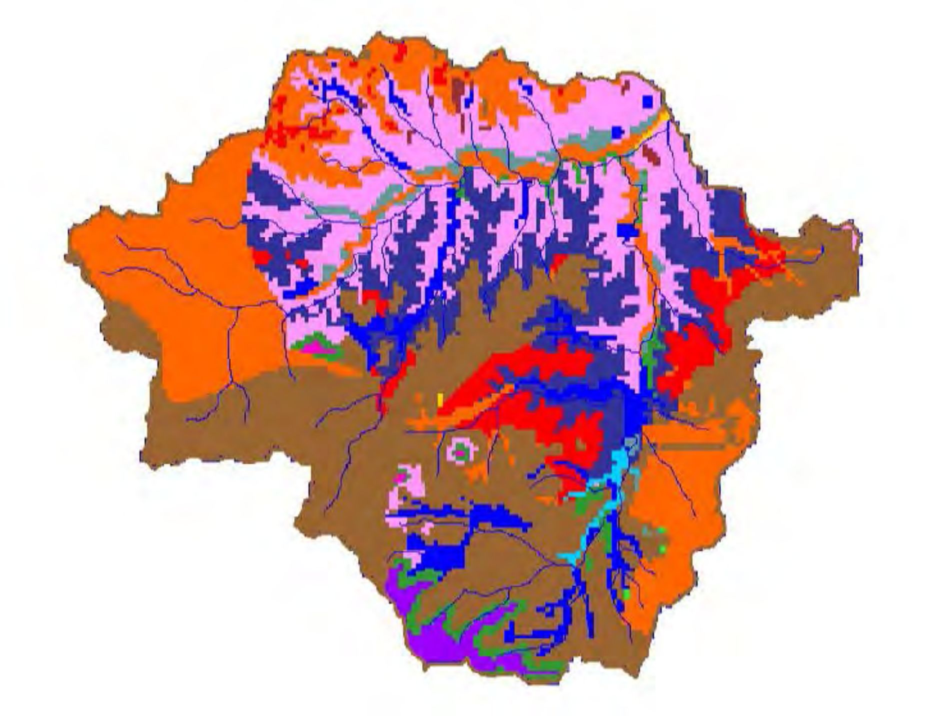
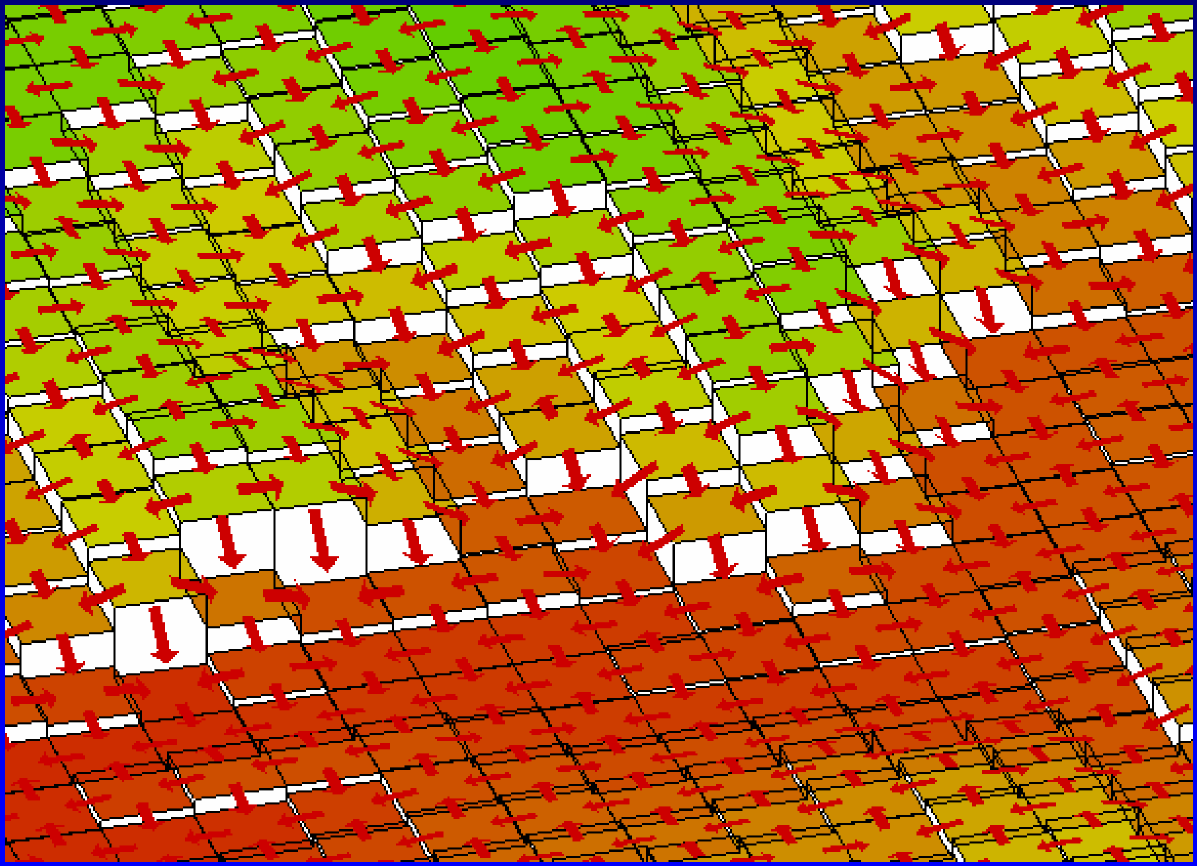




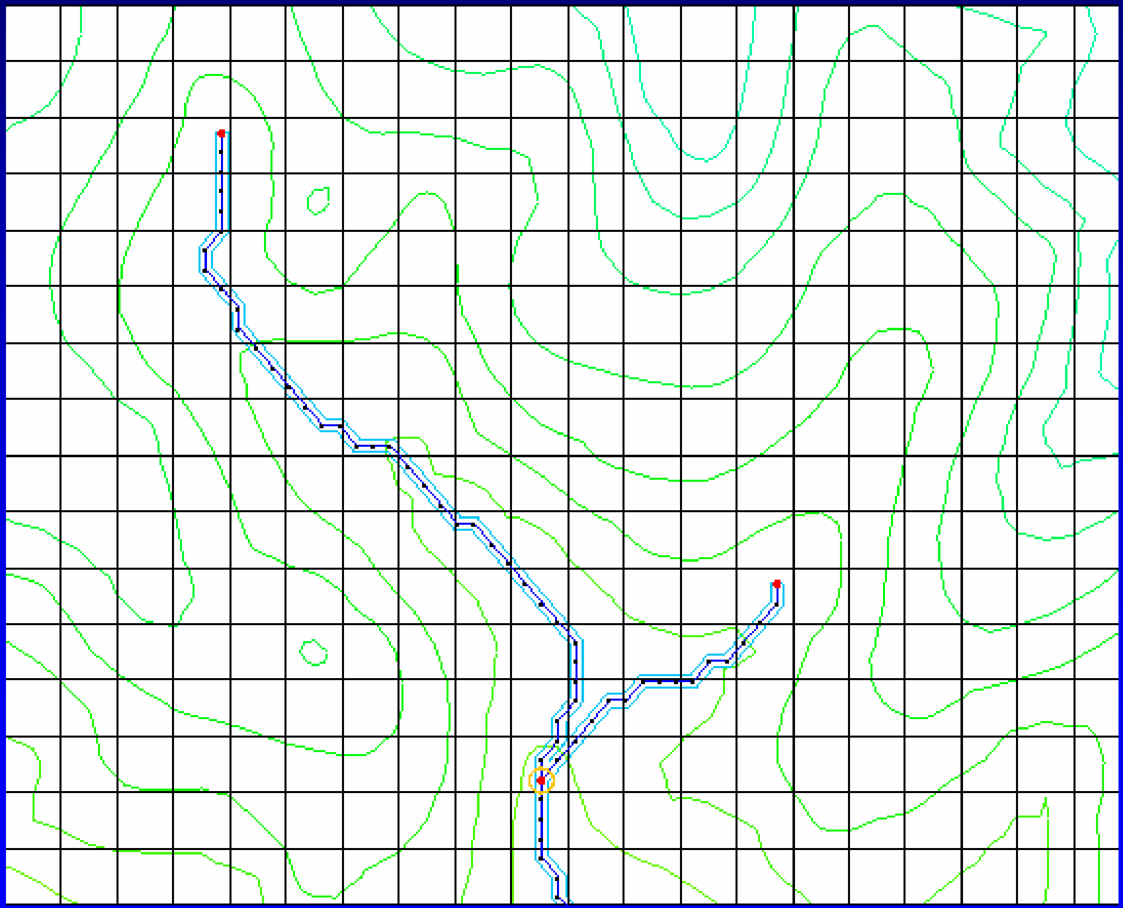
Cell-to-Cell Overland Flow

- **2D Overland Flow**



Channel Routing

- **1D Stream Flow**



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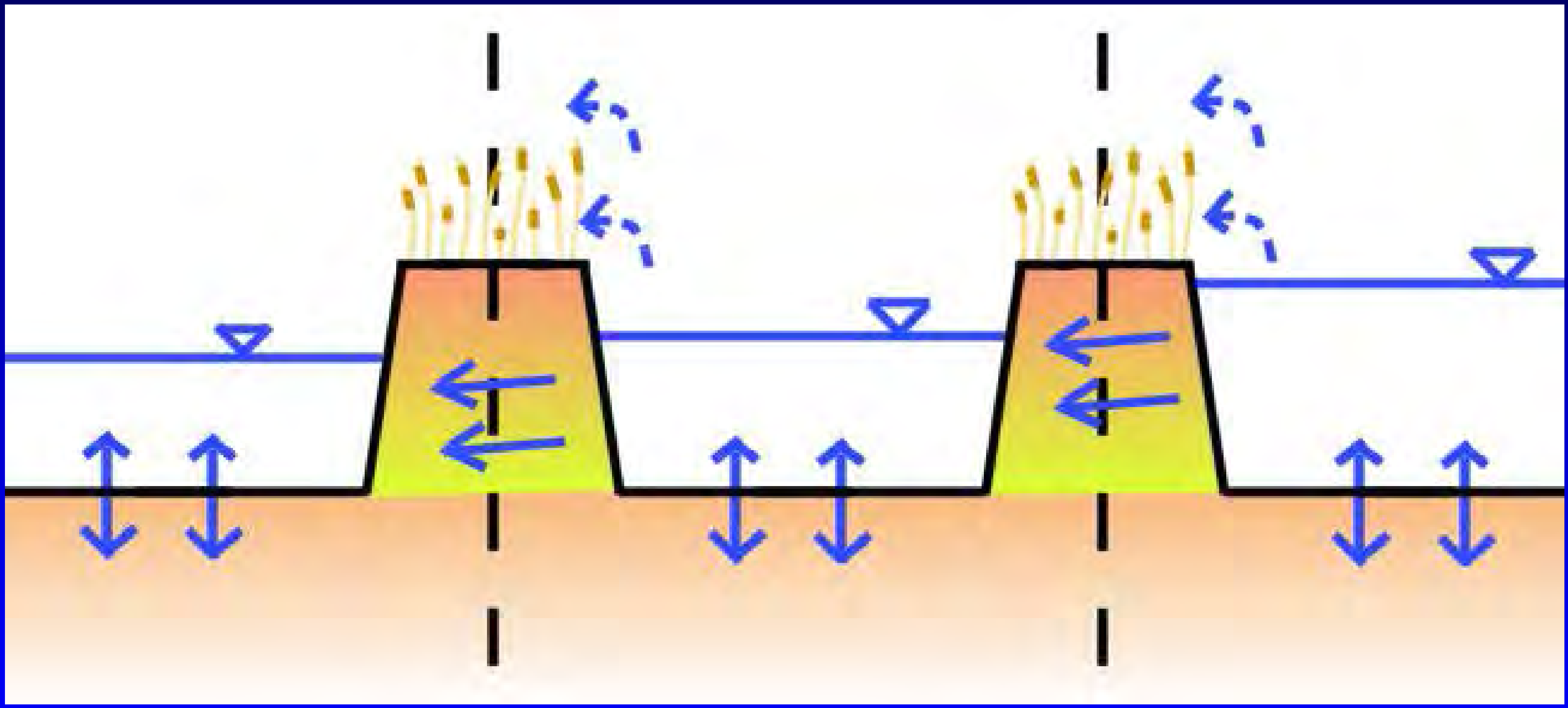
Wetlands



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of Engineers

Wetlands

- Specify:
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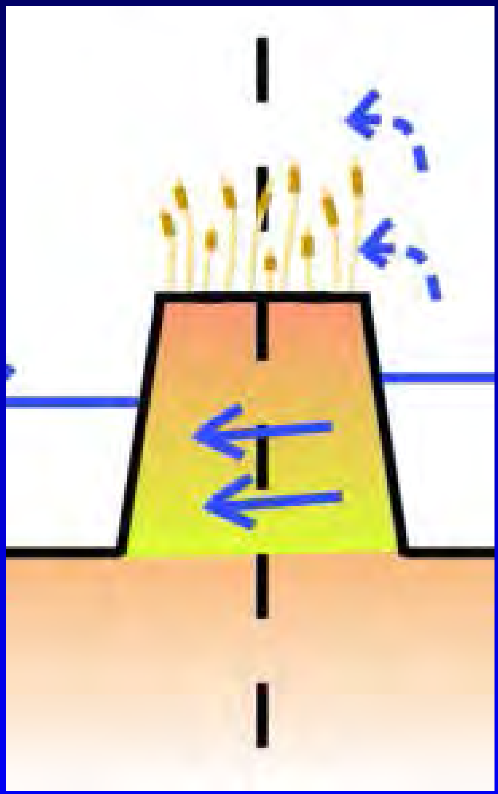

Wetlands

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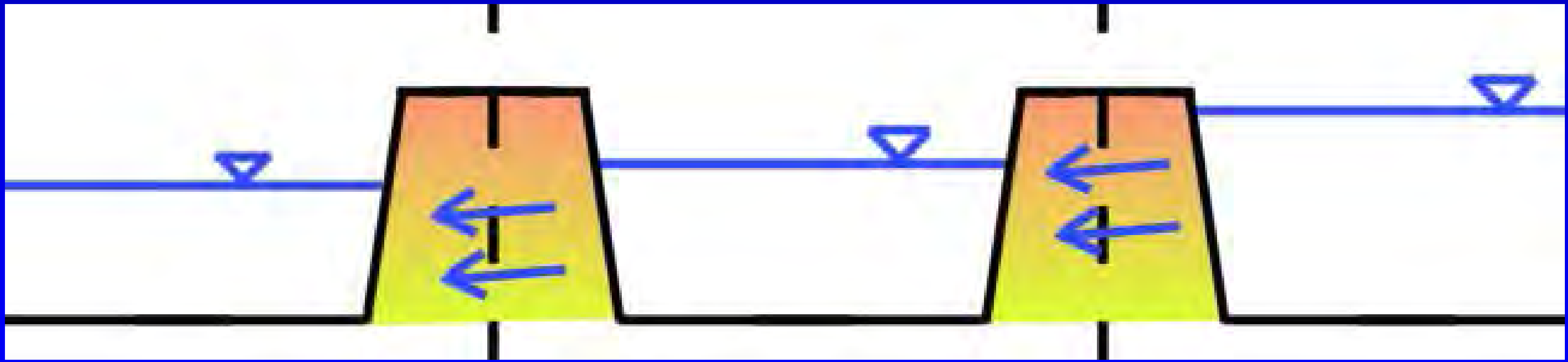

Wetlands

- **Overtopping flow (Flow Through Vegetation)**
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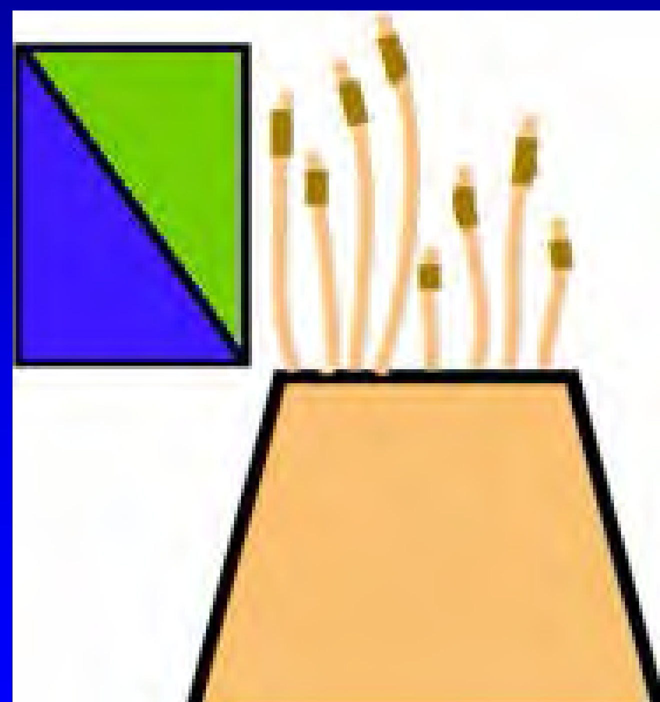
Manning's Flow

Darcian Flow



How to Obtain GSSHA

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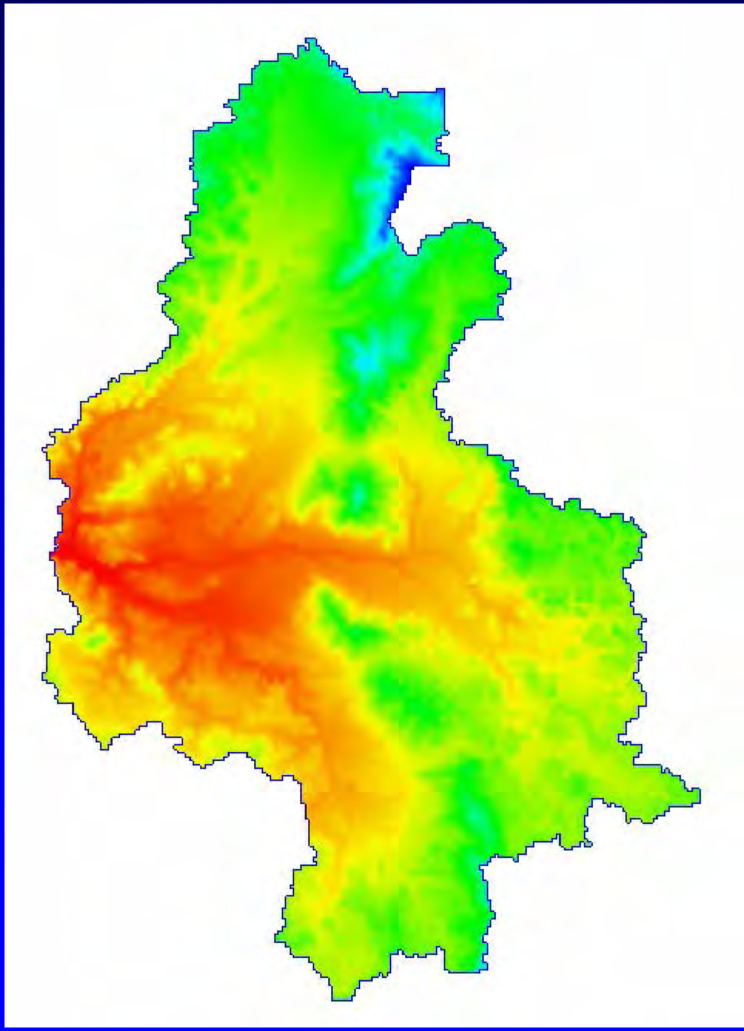
GSSHA Simulation of the Coon Creek Watershed



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- **8 Soil Types**
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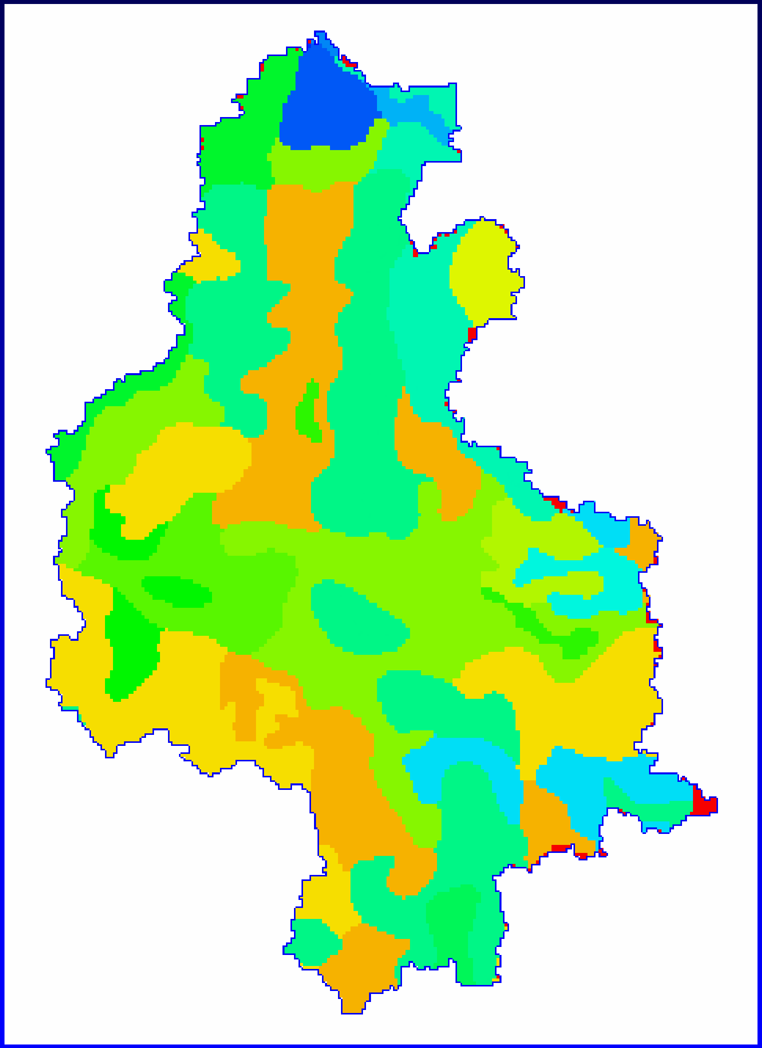
- **Simplified by similar surface, subsurface characteristics**



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  - Urban
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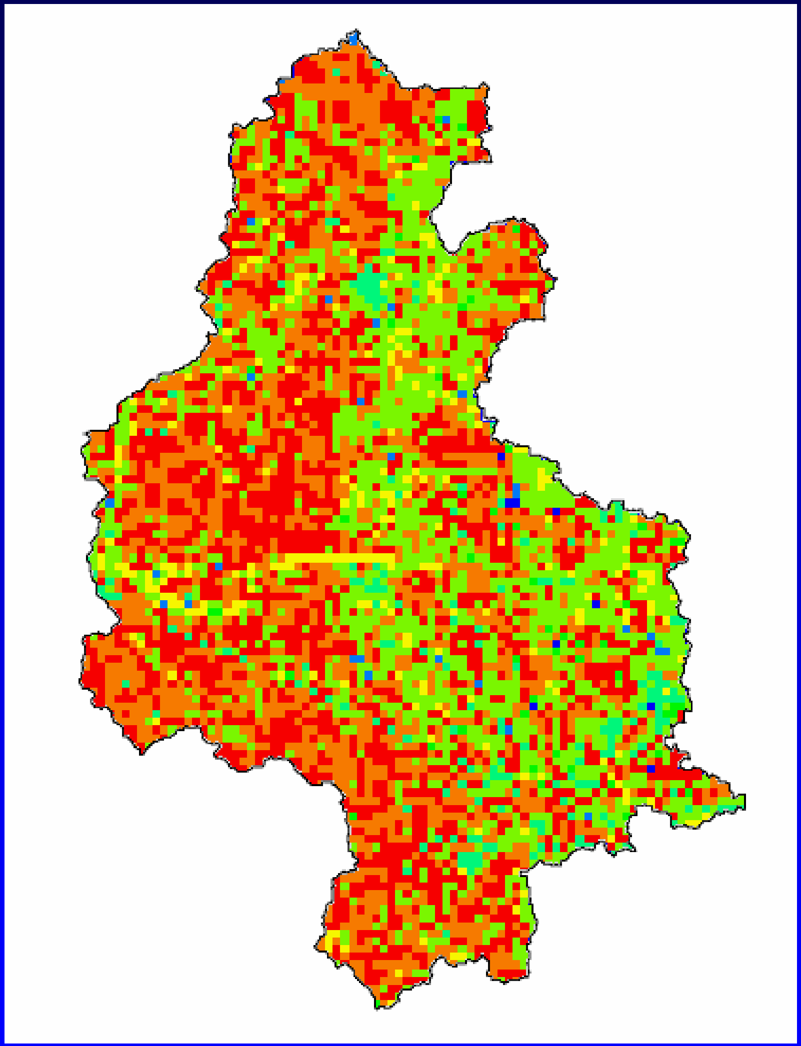
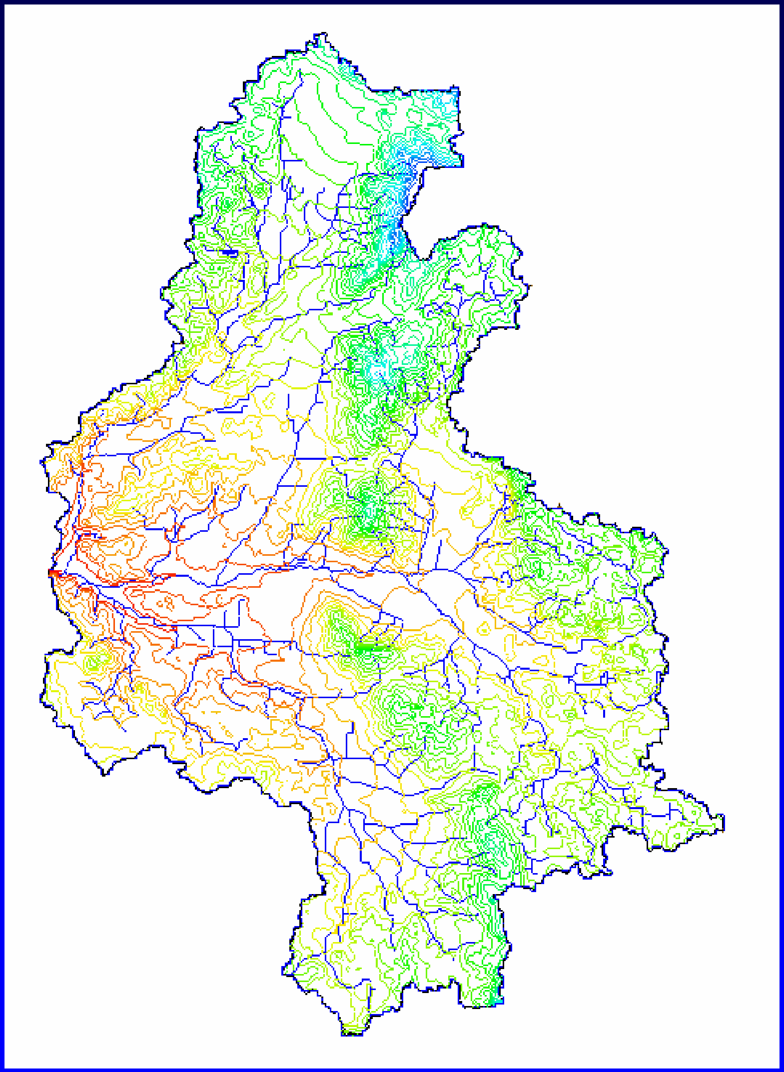
  - Soybeans
  - Forest
  - Wetlands
  - Grassland



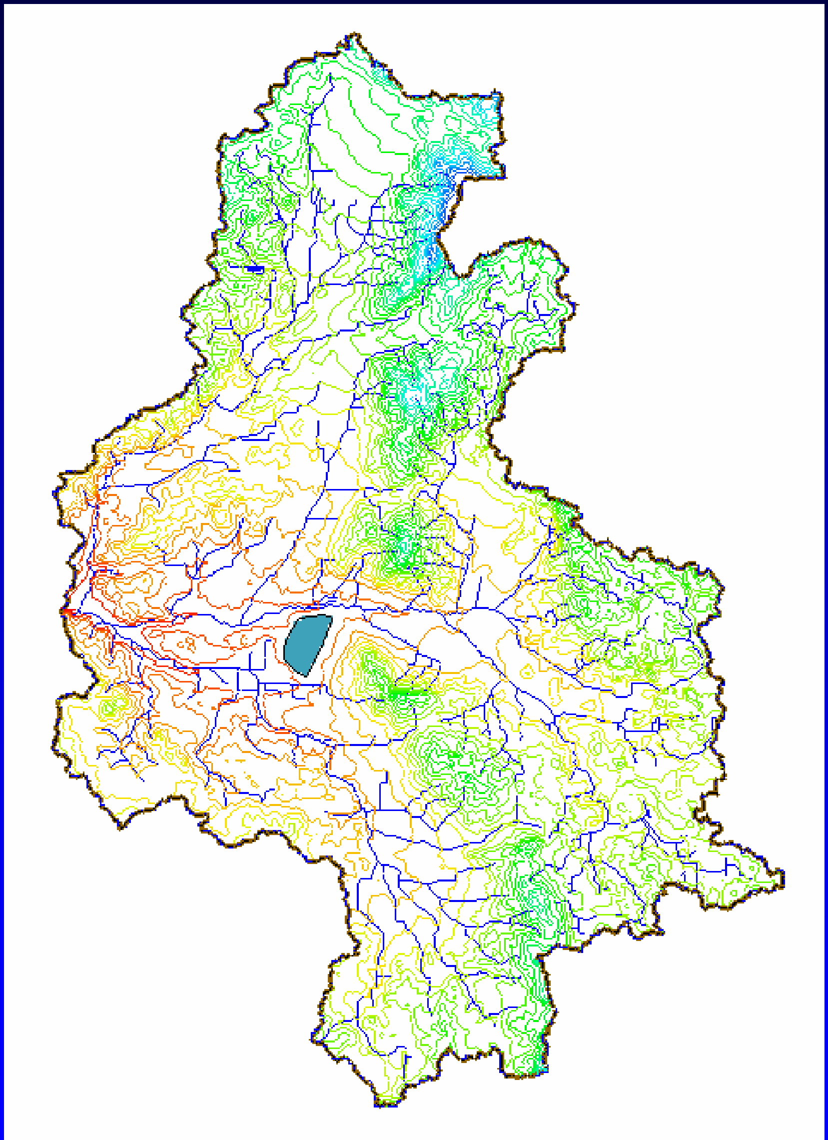
Project Goals

- Develop Watershed Management Plan
  - Placement of 1600 ac of wetlands
  - Removal of tile drain
  - Assess impacts of future land use

Baseline



Wetland #1



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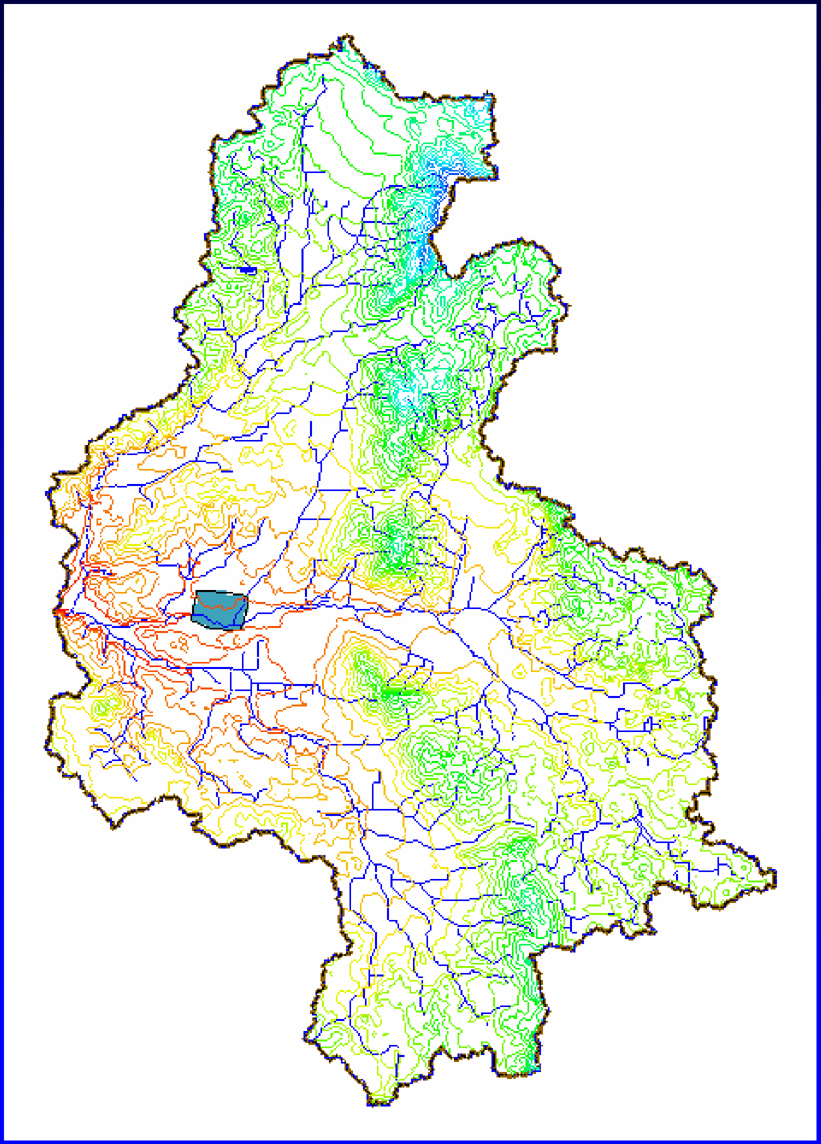
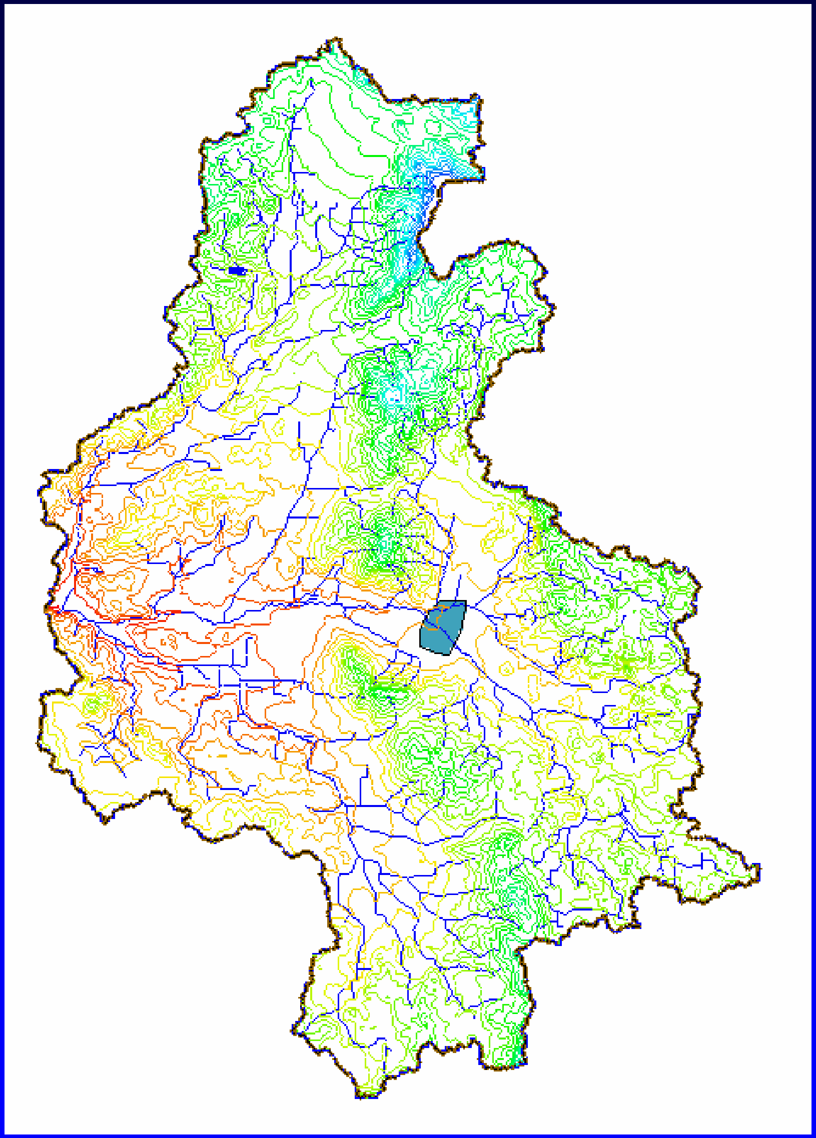
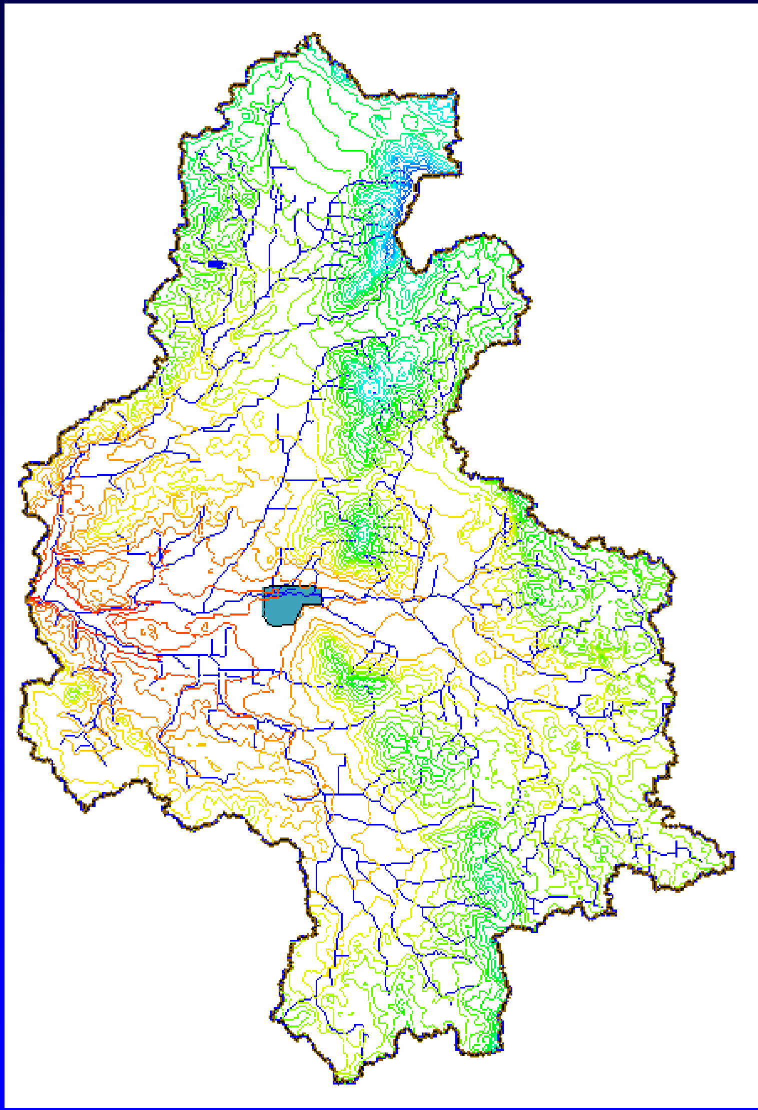
Wetland #2



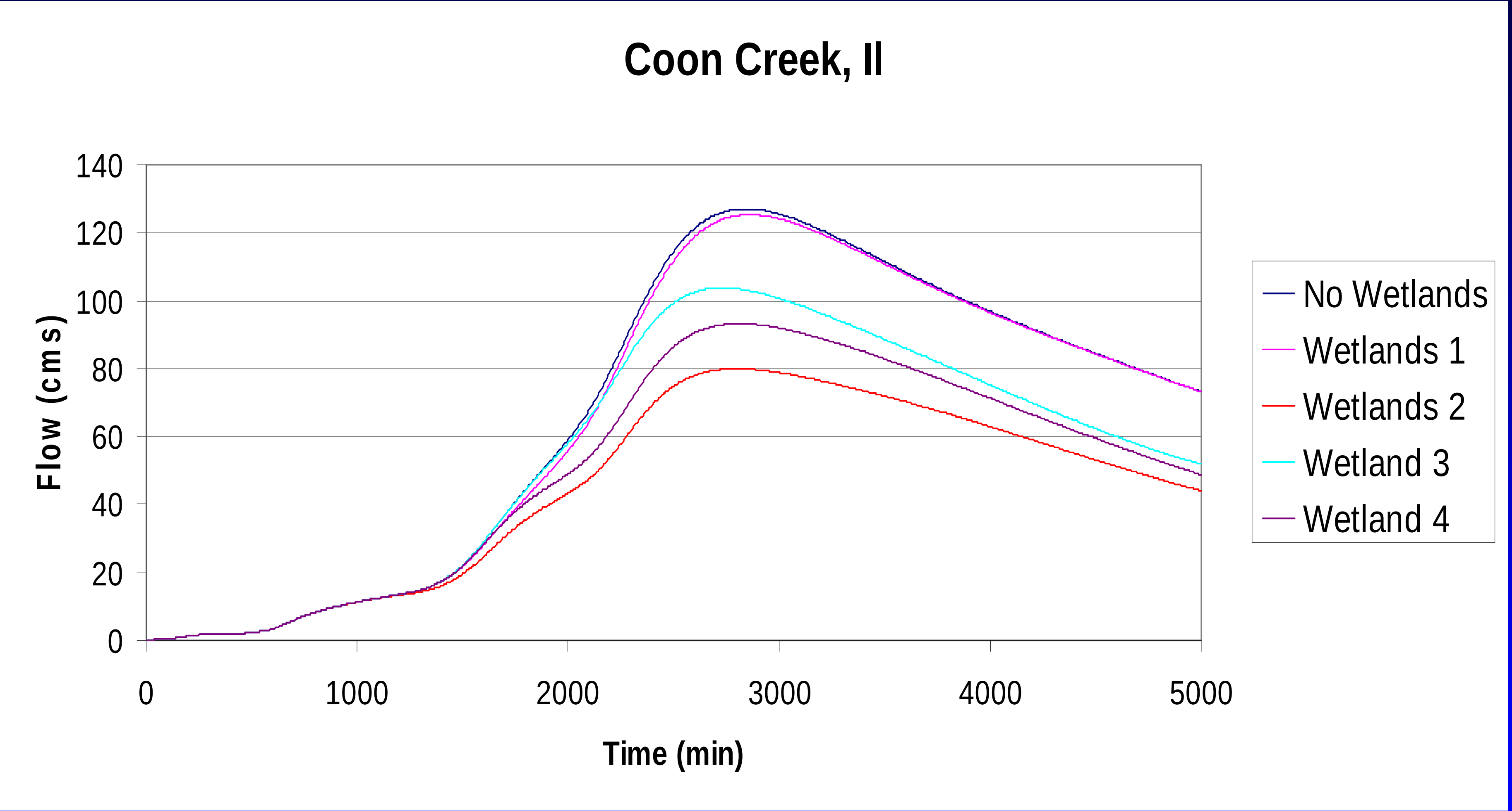
Wetland #3



Wetland #4



Results



Coon Creek, Il
Flow (cm s)
140
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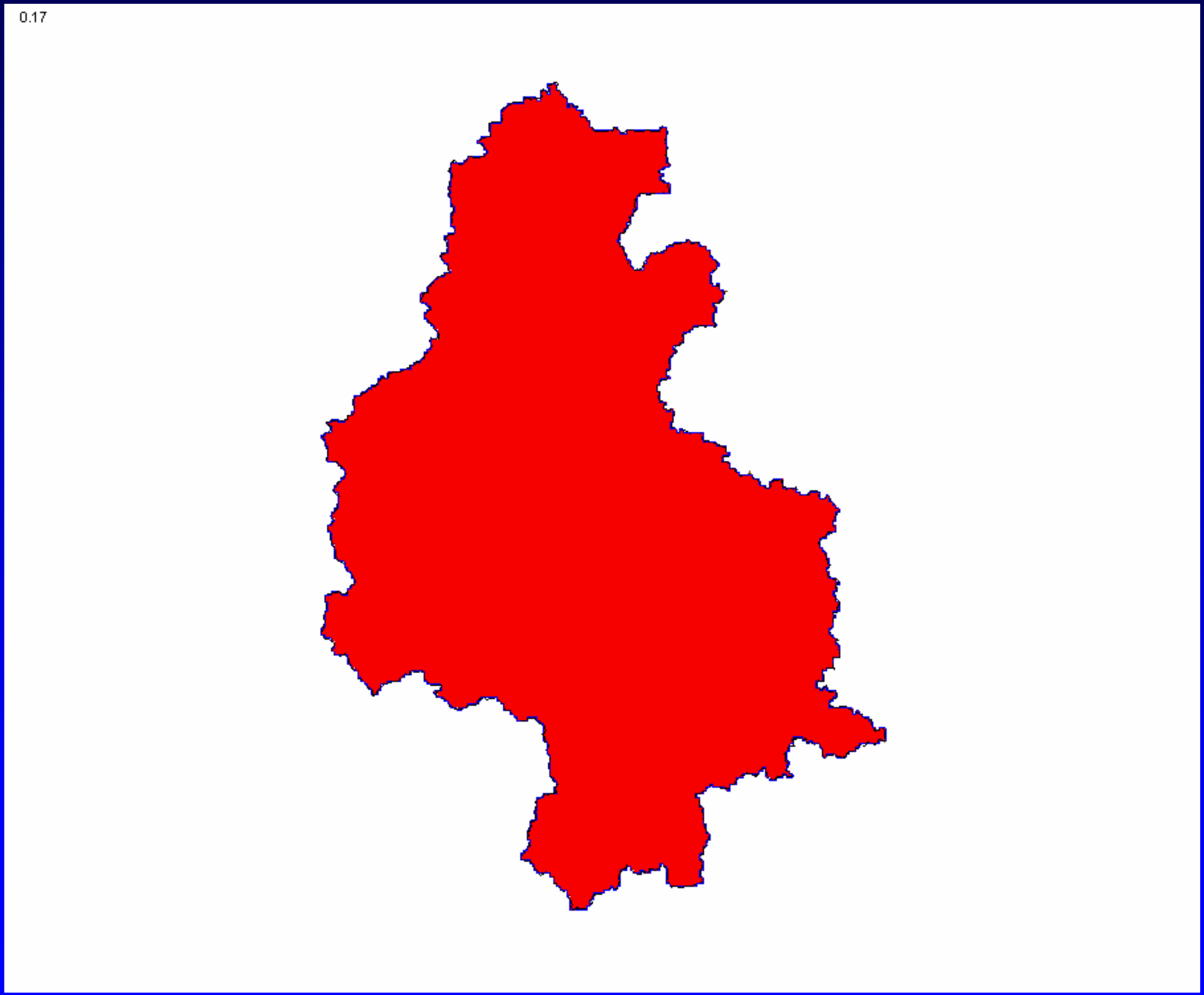
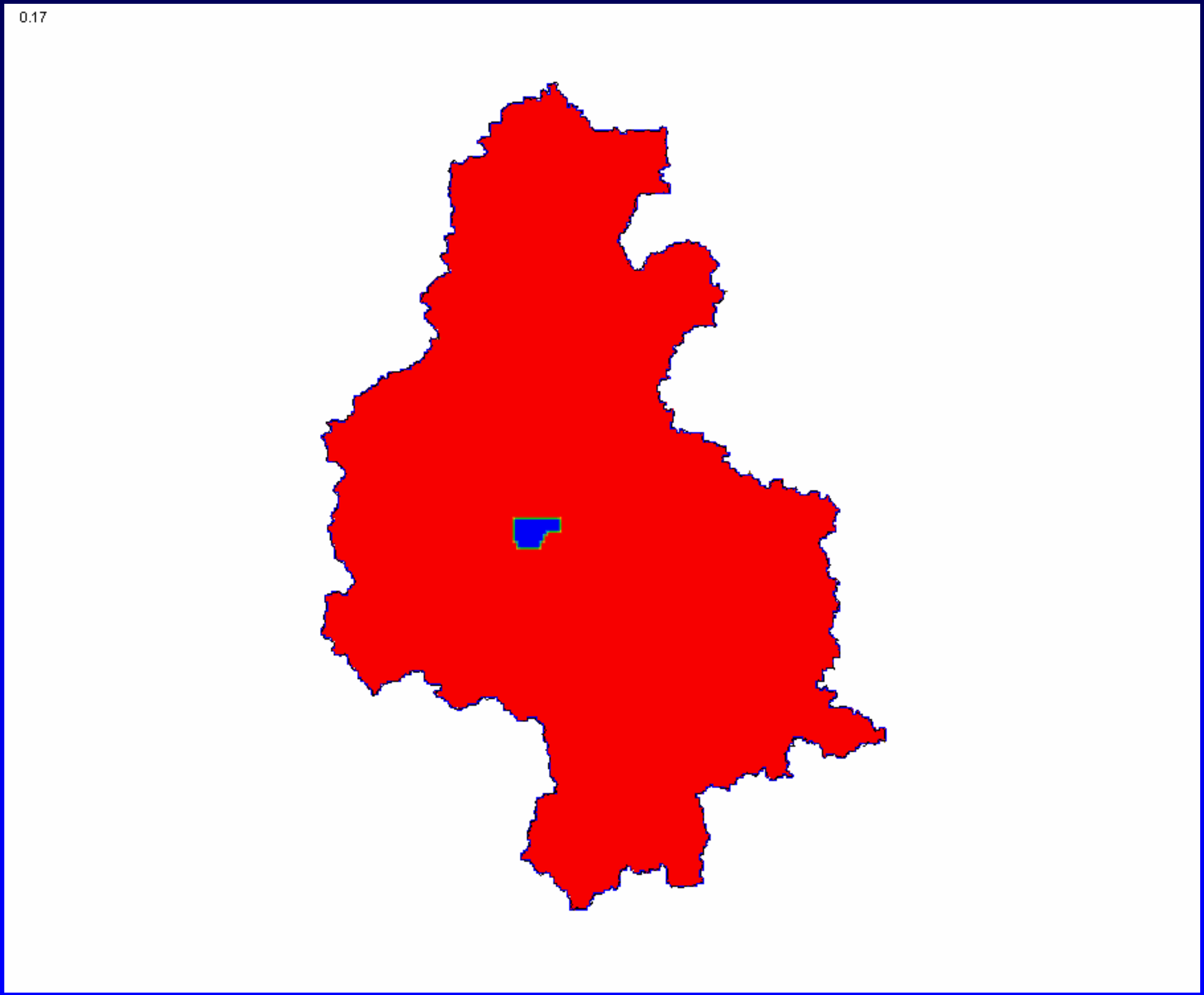
Baseline AVI



Wetlands #4 AVI



Close-up of Baseline

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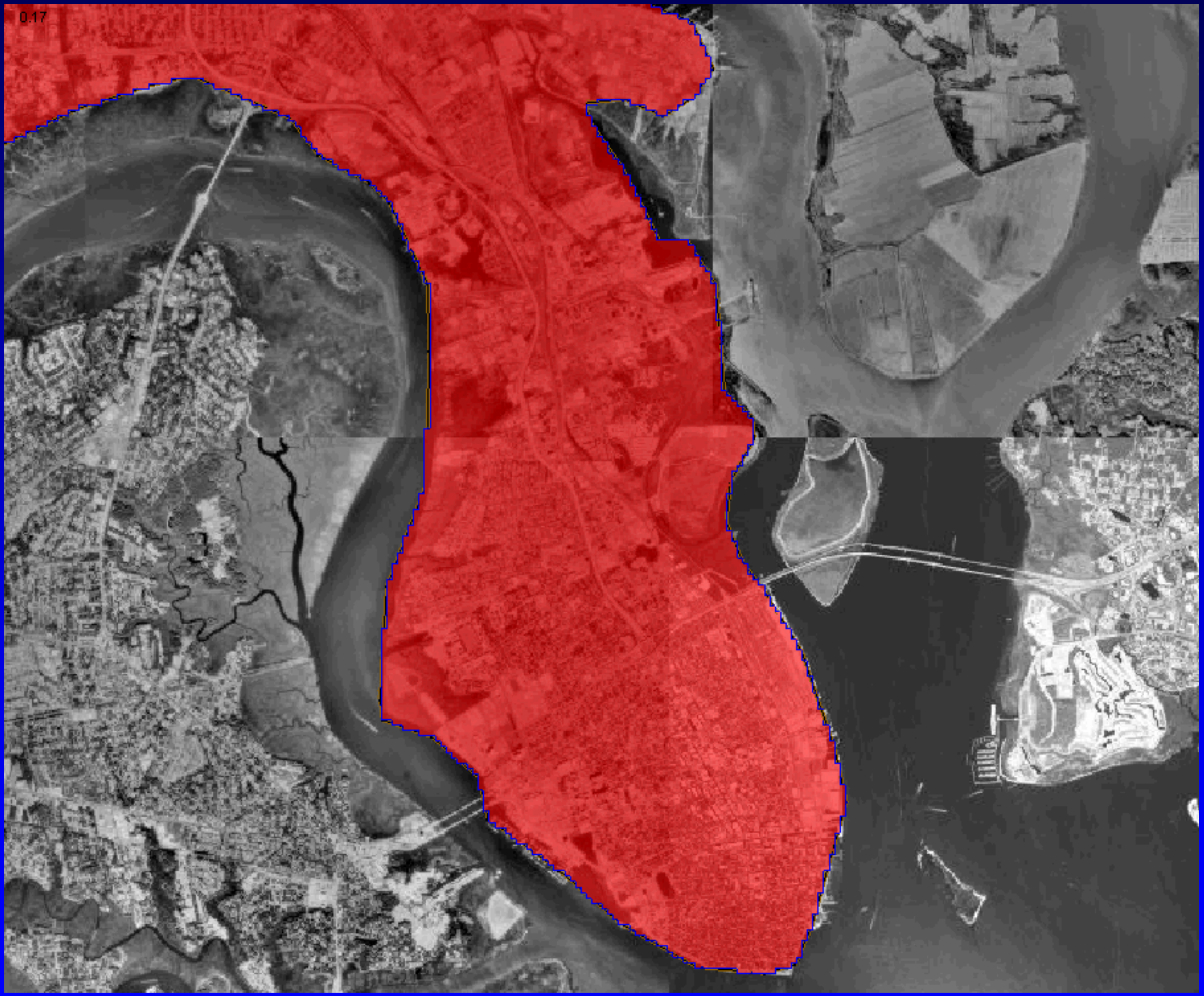
of Engineers

Bonus: Storm Surge Modeling



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of Engineers

Engineer Research and Development Center

Questions? Comments?

Aaron.R.Byrd@erdc.usace.army.mil

Advances to the GSSHA model

Aaron Byrd

Cary Talbot

ERDC-CHL

System-Wide Water Resources Program (SWWRP)

- 7-year USACE R&D initiative designed to assemble and integrate the diverse components of water resources management
- The ultimate goal is to provide to the Corps, its partners, and stakeholders the overall technological framework and analytical tools to restore and manage water resources and balance human development activities with natural system requirements

System-Wide Water
SWWRP
Resources Program
Water Resources Depot

https://swwrp.usace.army.mil

SWWRP Program Structure

USACE/National Water Resource Needs

Regional Water Management

- Watershed Hydrology Simulation
- Riverine & Estuarine Simulation
- Coastal Simulation
- Water Processes & Assessments

Regional Sediment Management

- River Basin Morphology, Modeling, & Management
- Coastal Morphology, Modeling, & Management
- Sediment Management Methods
- Sediment Processes Studies

Ecosystem Assessment & Management

- Landscape Assessment
- Transport Modeling
- Ecological Modeling
- Ecosystem Response Forecasting
- Ecosystem Processes

Unifying Technologies

- Integrating Frameworks
- Data Management
- Geospatial Applications Development
- Regional Measurement and Monitoring
- Model Integration
- Decision Support and Knowledge Management

Corps Business Lines

SWWRP
Watershed Hydrology Simulation

- 5 Research Areas
  - HMS development
  - GSSHA development
  - Uncertainty/parameter estimation/stochastic simulation tools for system-scale models
  - Regional flood prediction
  - Coupled, multi-dimensional groundwater-surface water interaction simulation

GSSHA

- Distributed, physically-based Gridded Surface Subsurface Hydrological Analysis (GSSHA) model
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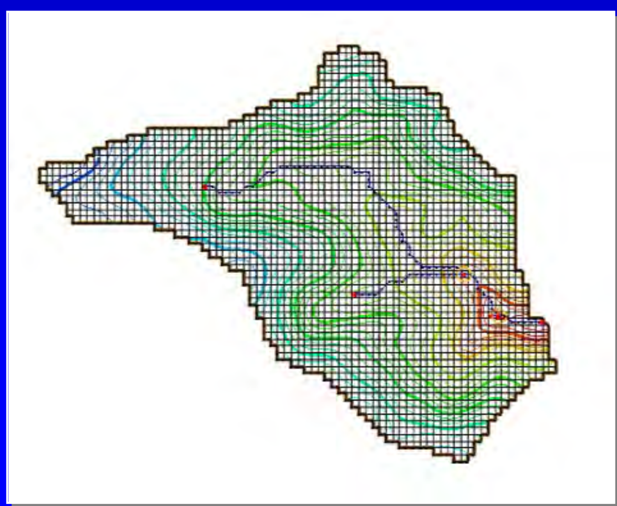

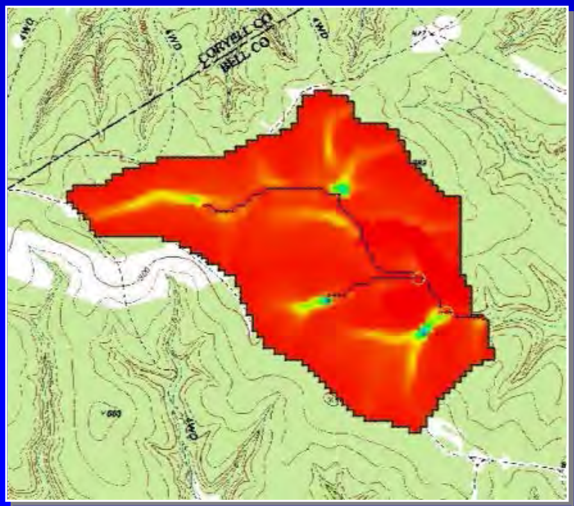

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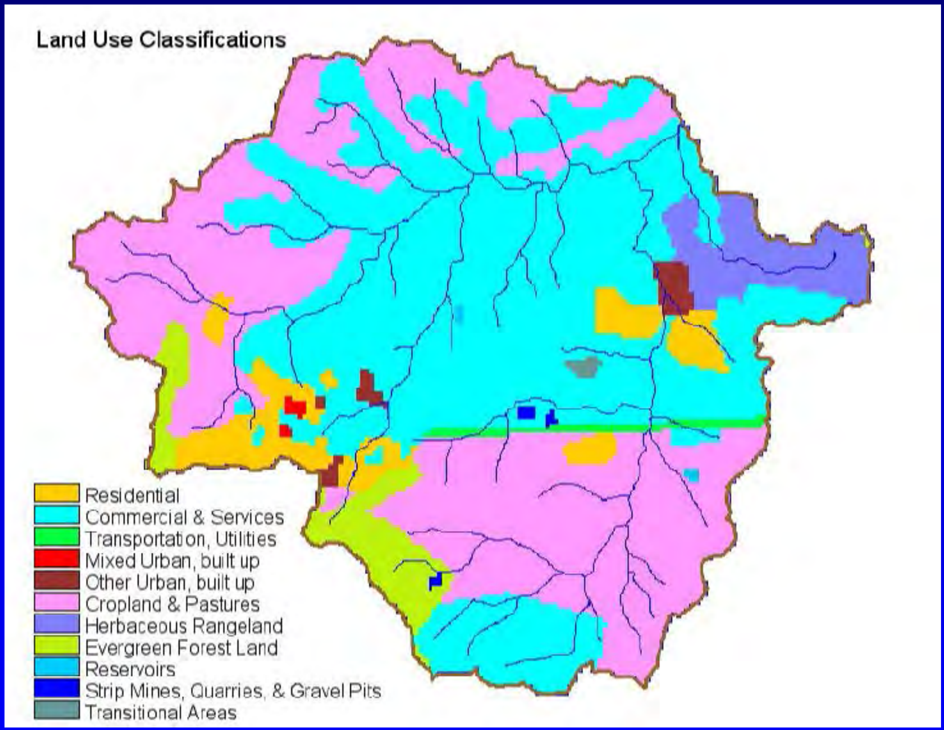

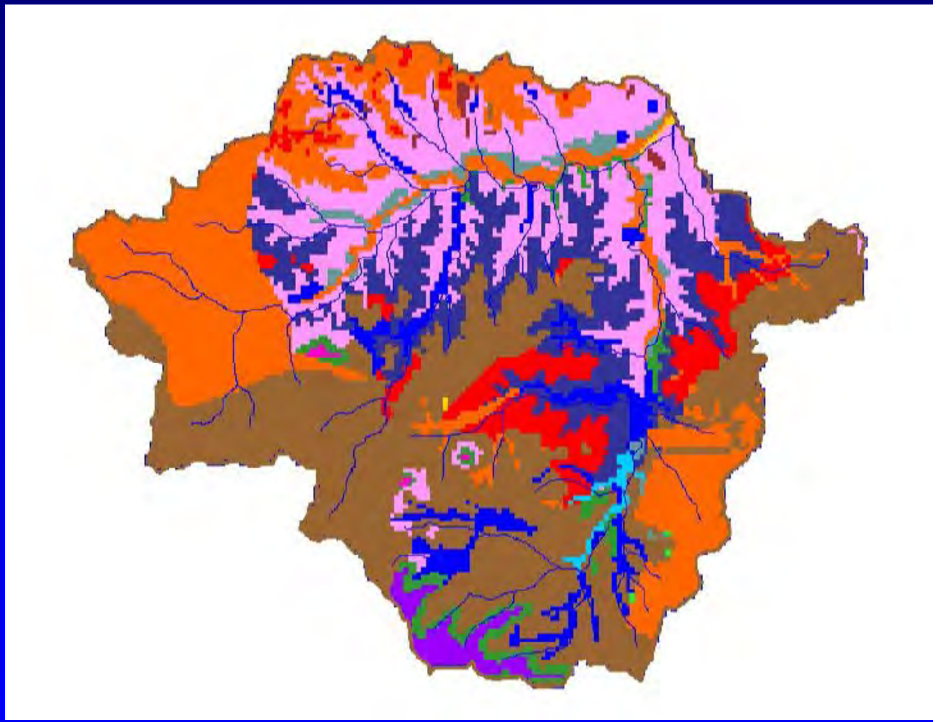

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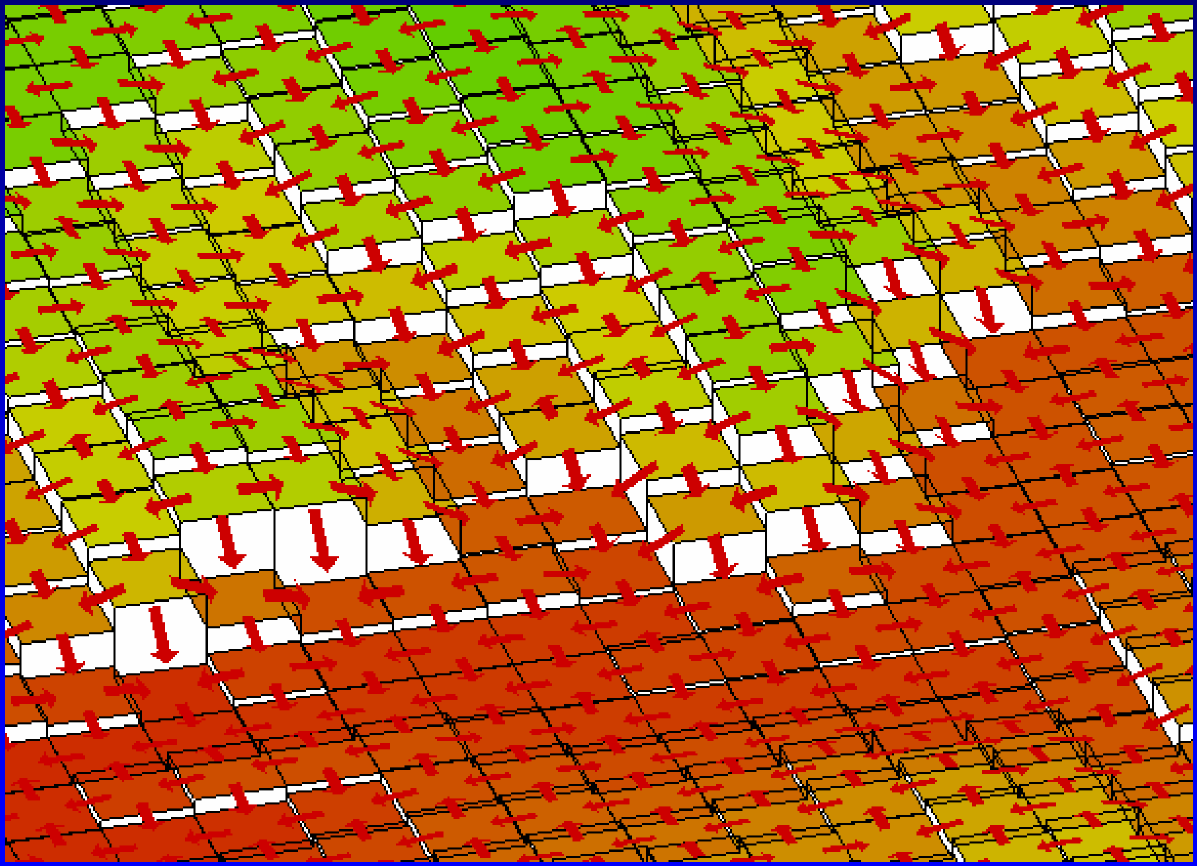

Channel Routing

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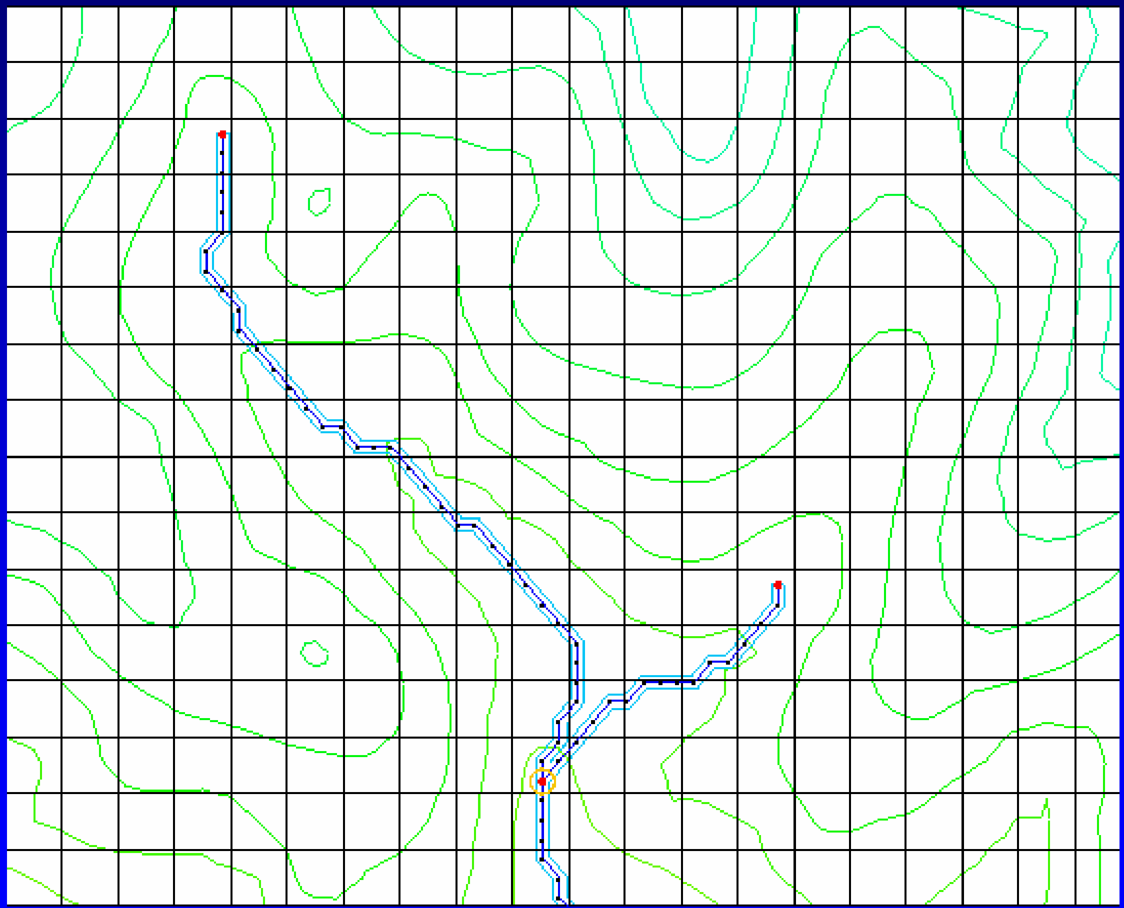

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of Engineers

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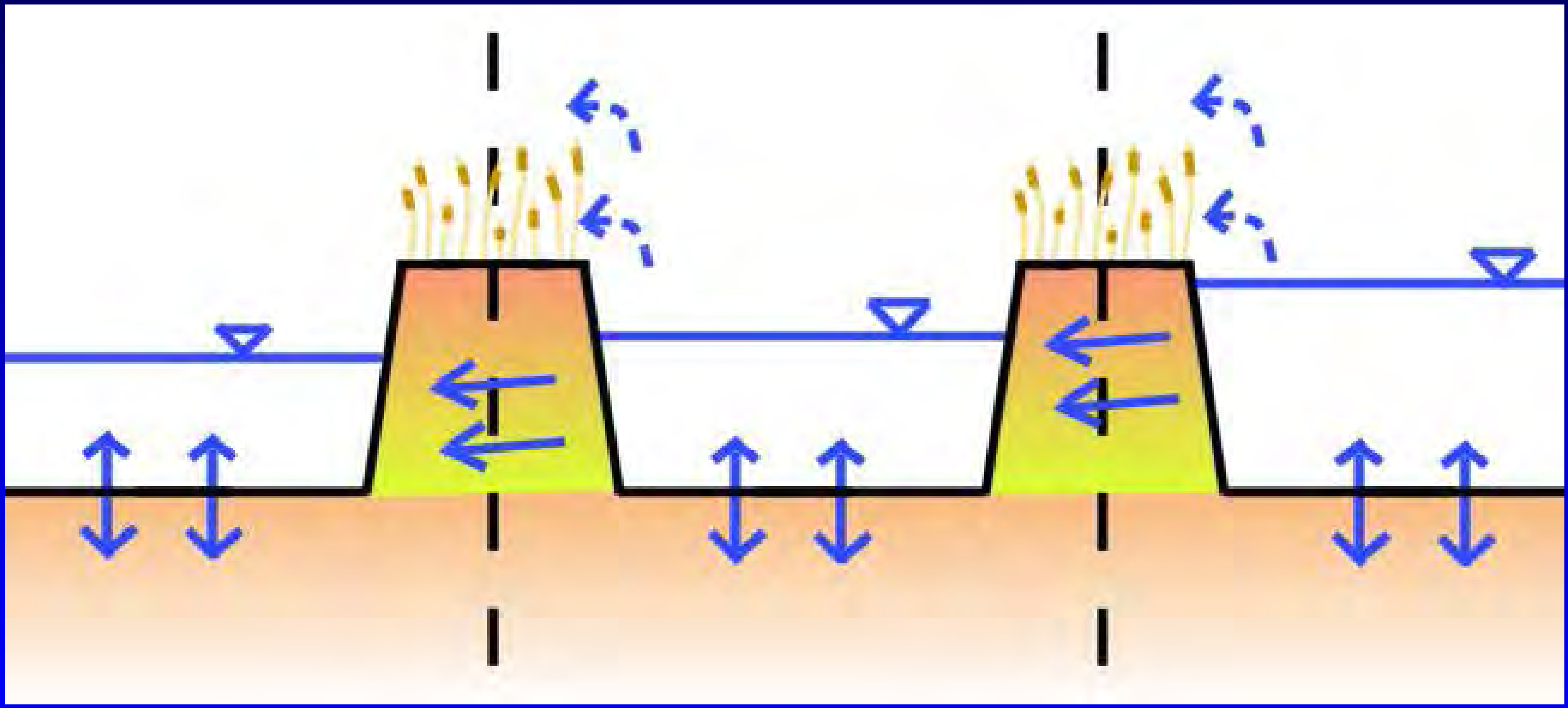

US Army Corps
of Engineers

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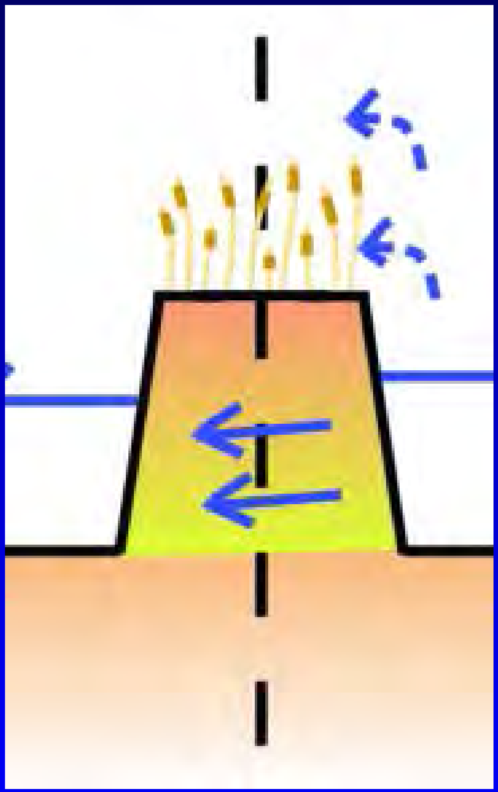

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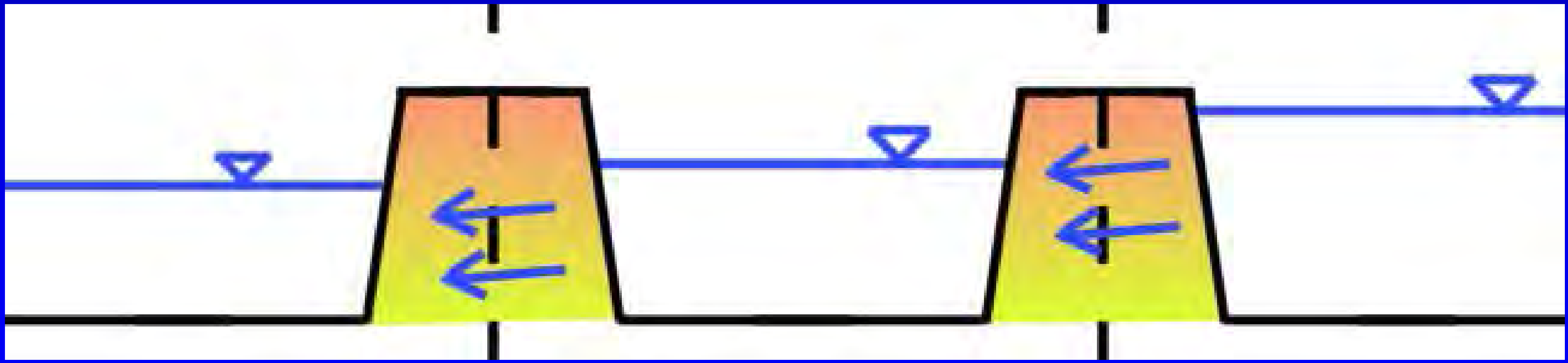

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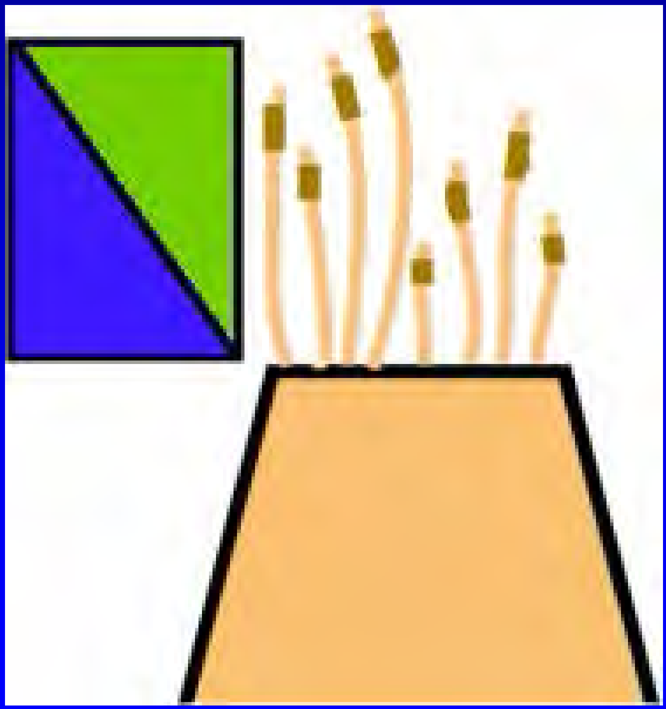

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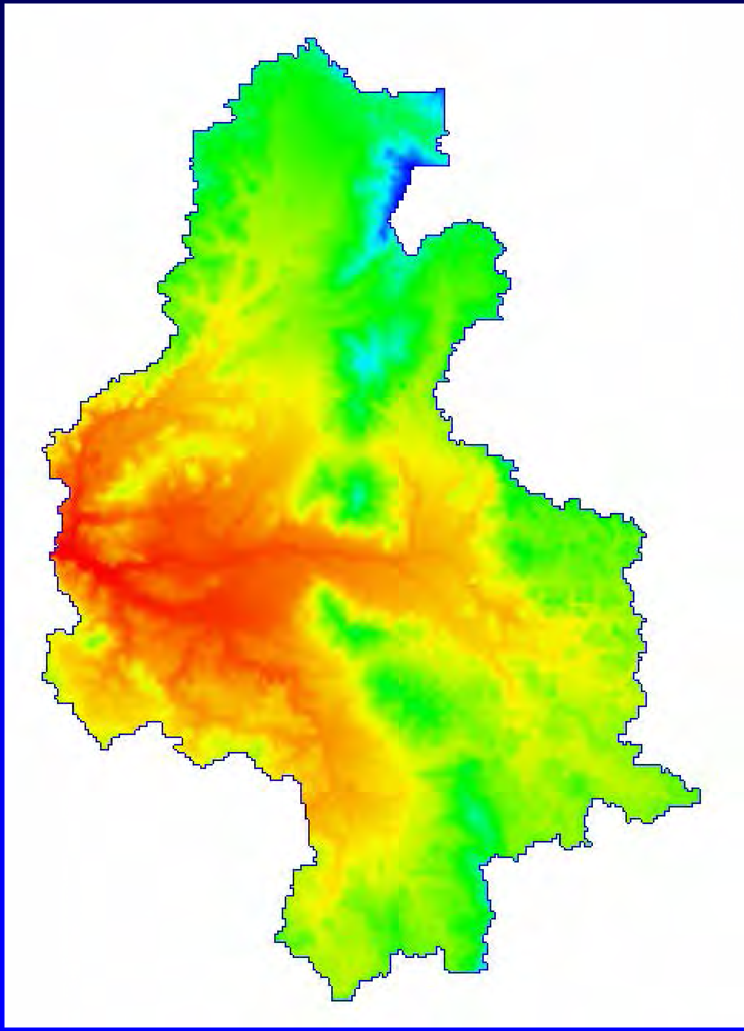

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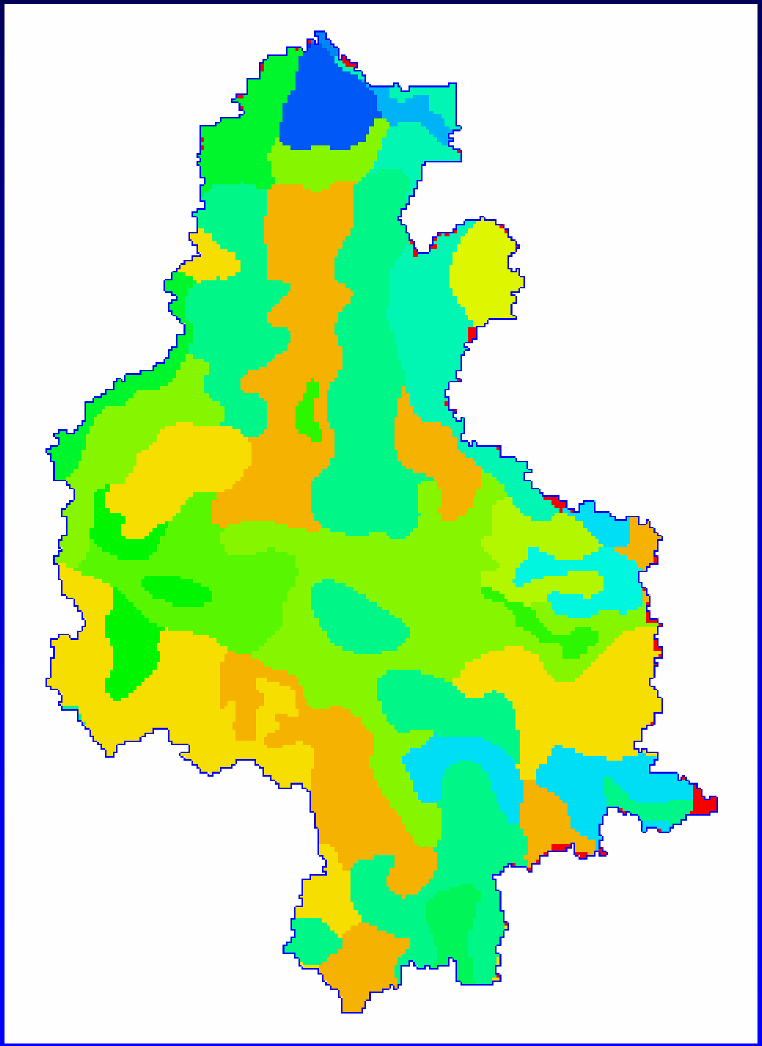

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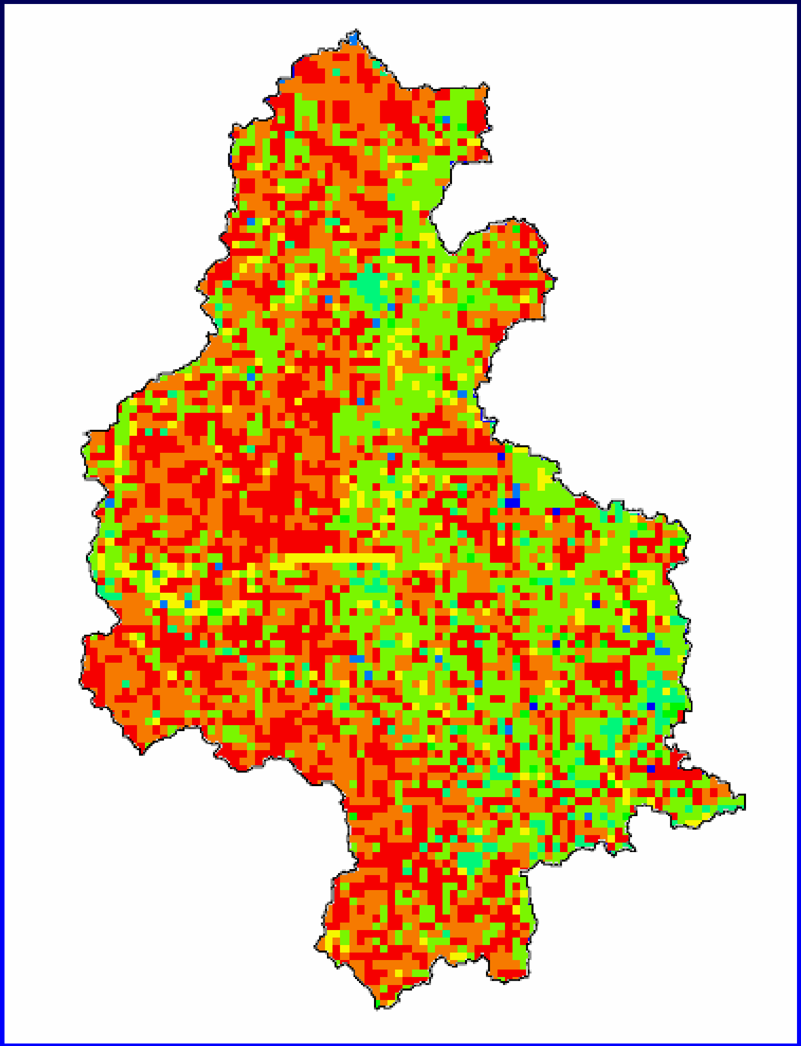

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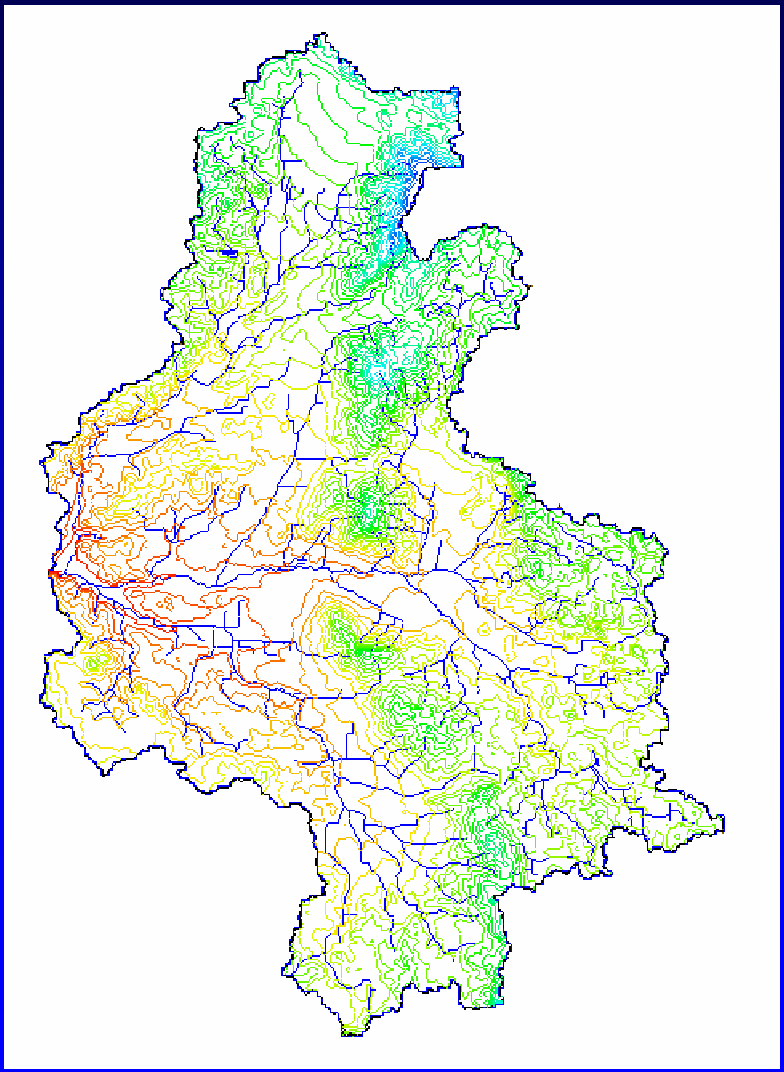

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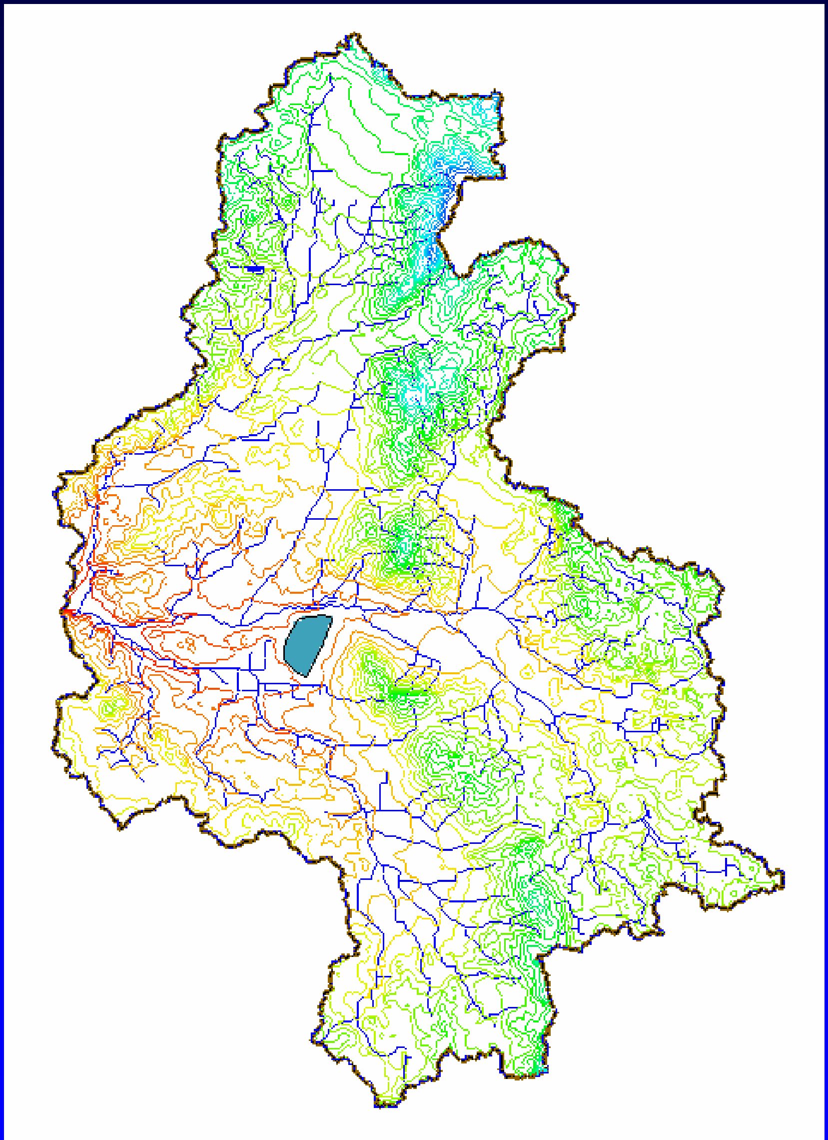
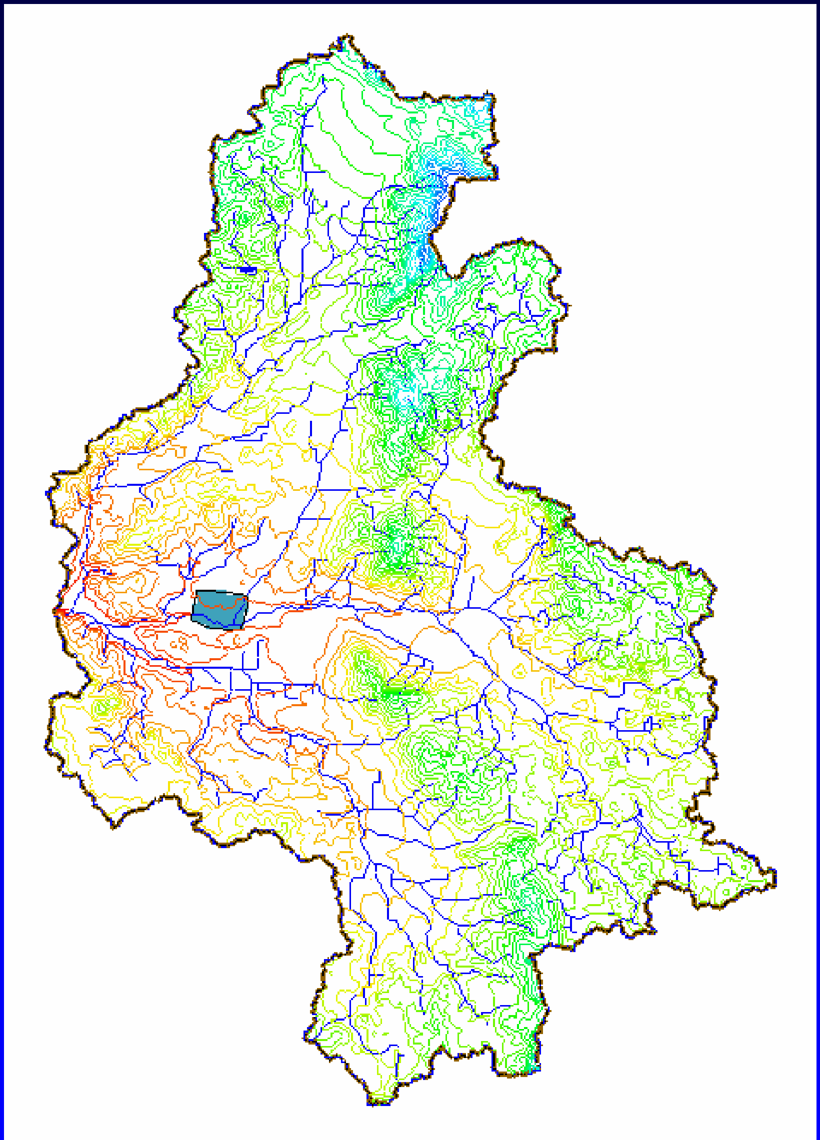
Engineer Research and Development Center

Wetland #1

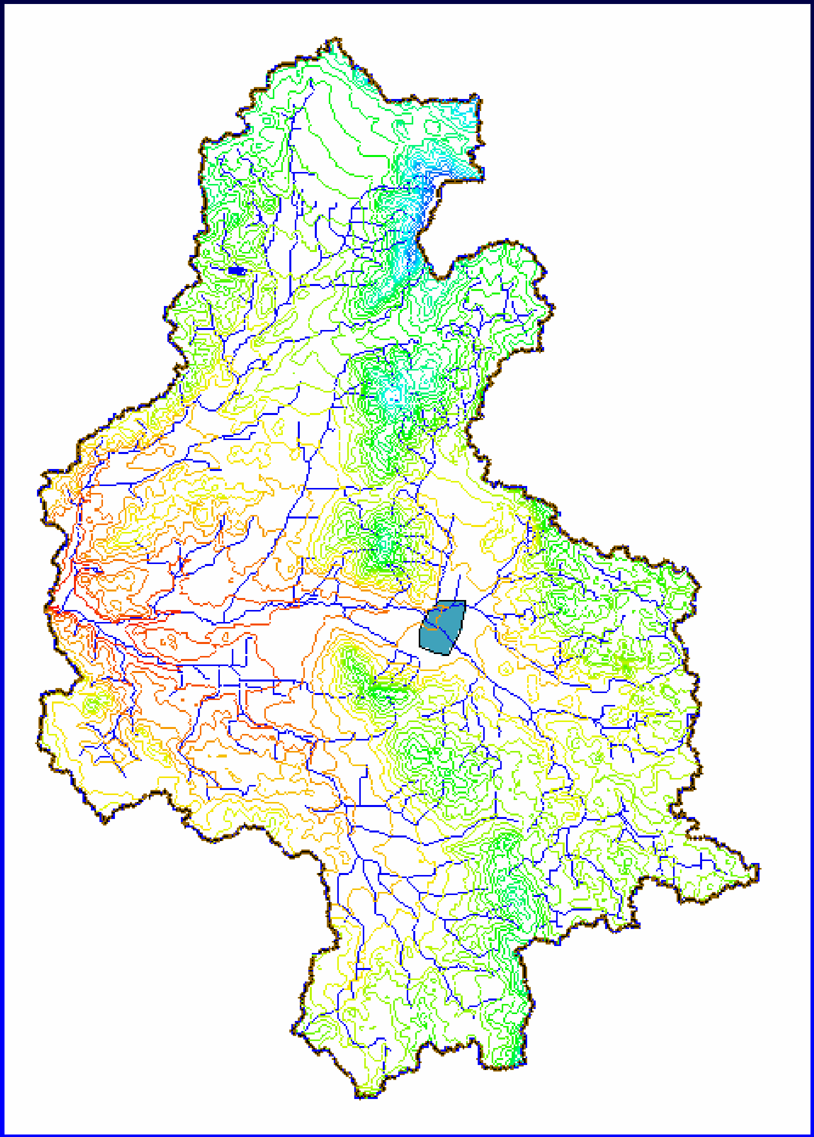


US Army Corps
of Engineers

Wetland #2



Wetland #3



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of Engineers

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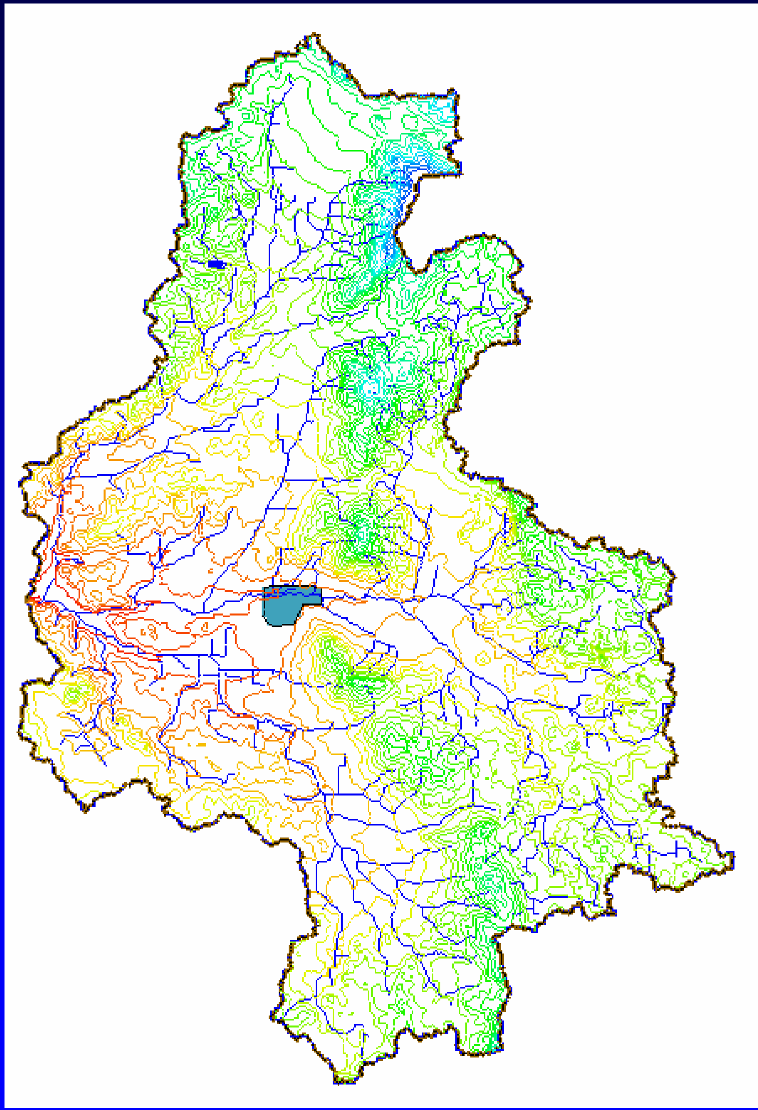
Wetland #4



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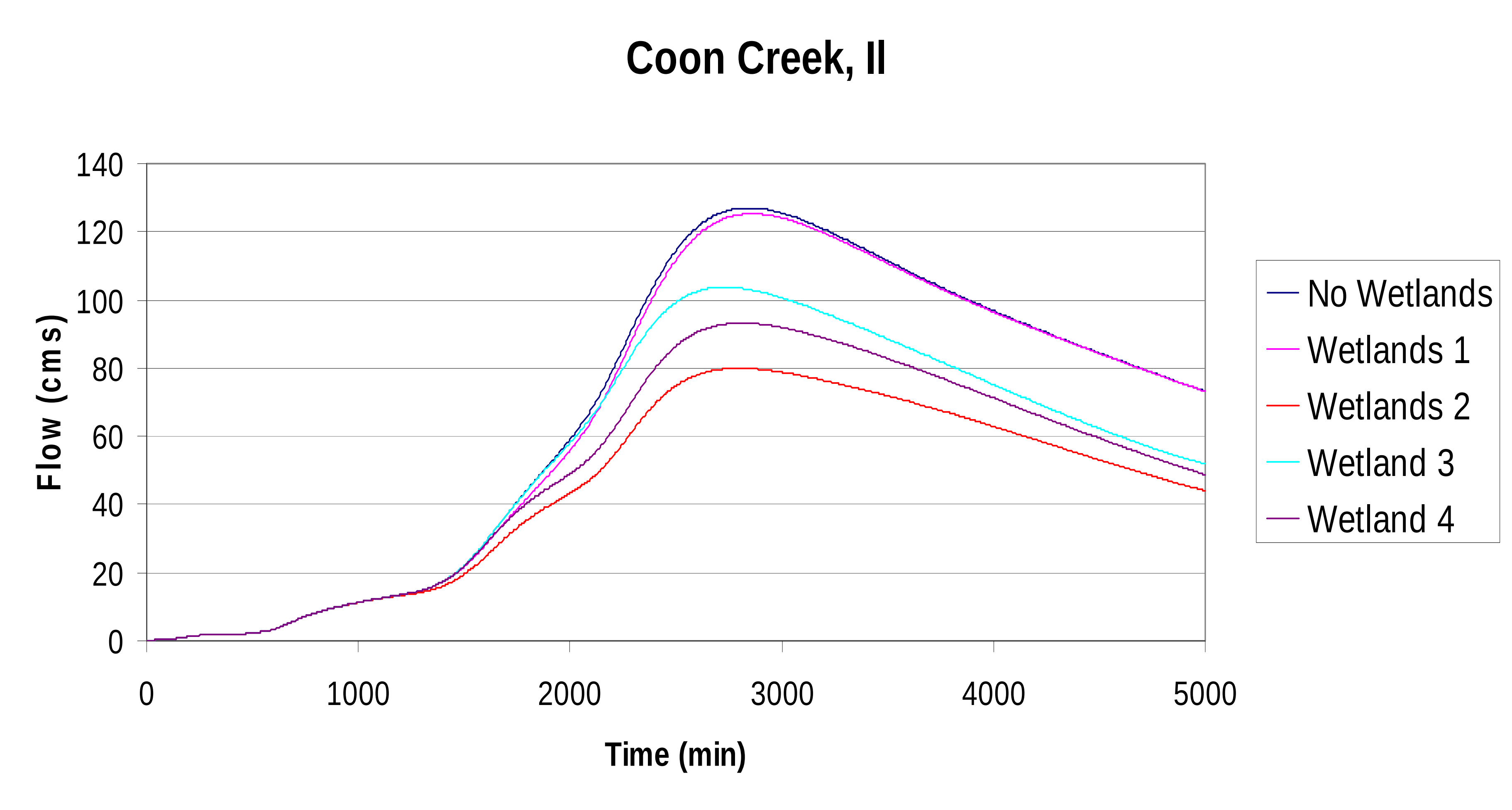

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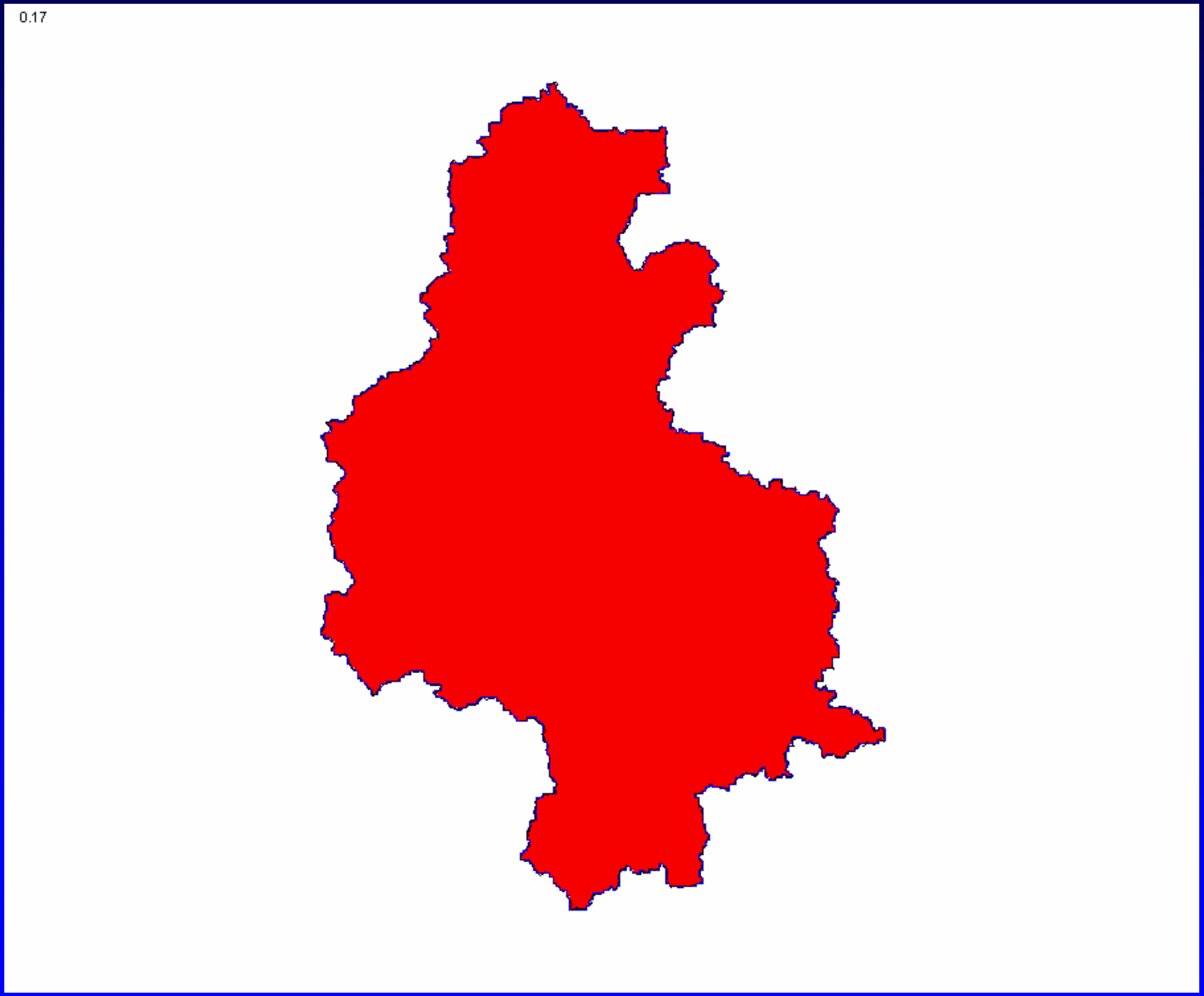
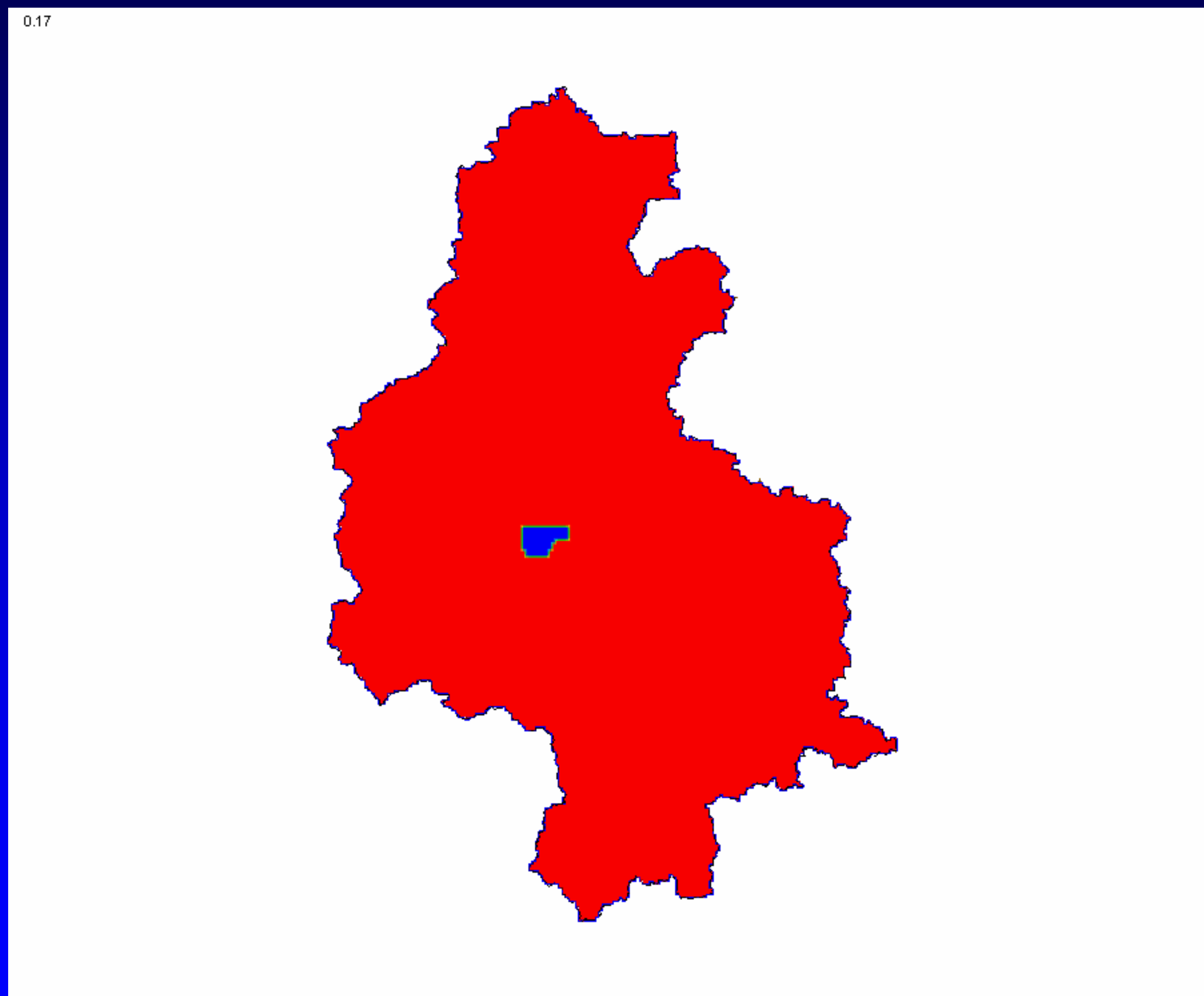
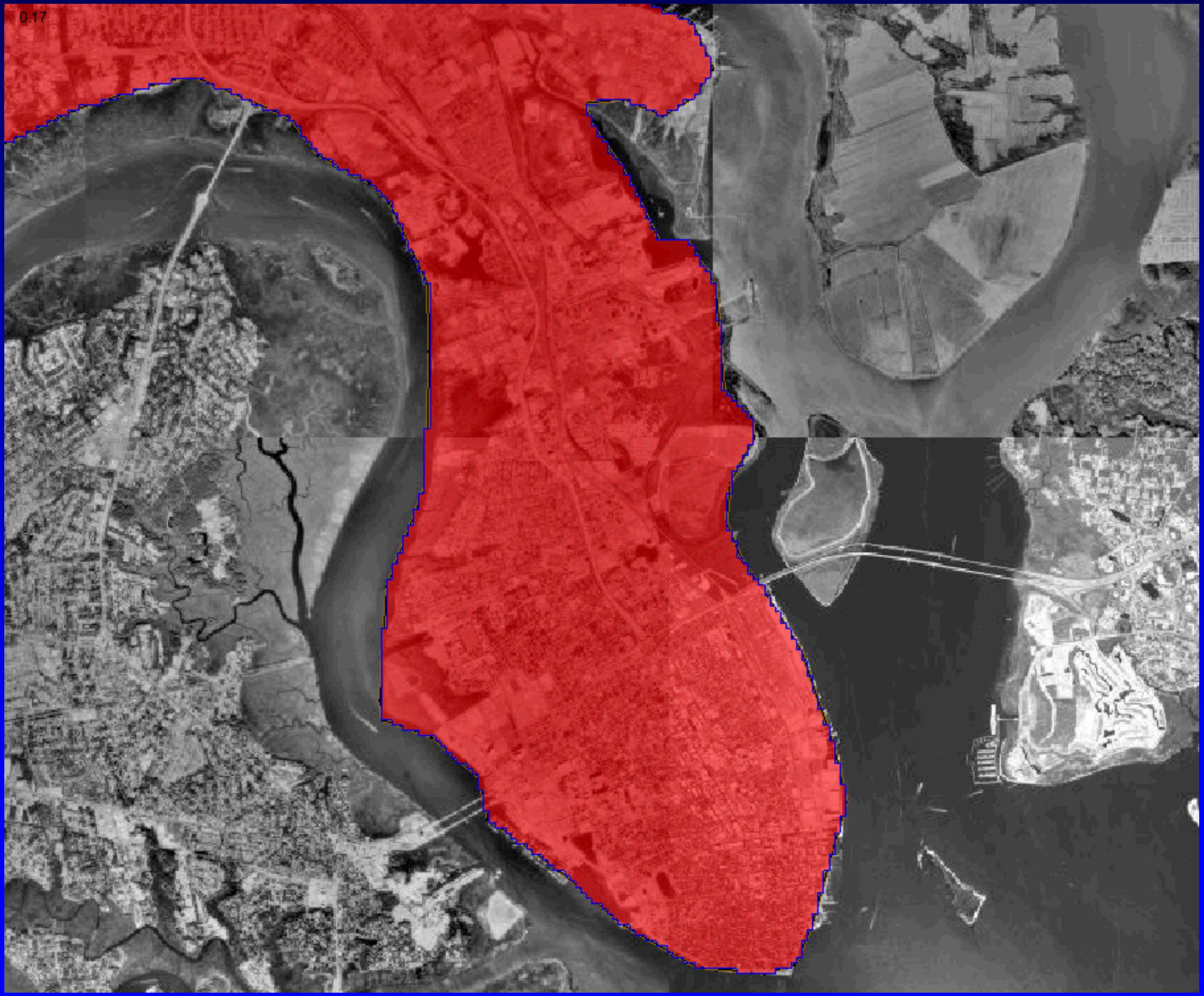


Wetlands #4 AVI



Close-up of Baseline

Bonus: Storm Surge Modeling



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Questions? Comments?

Aaron.R.Byrd@erdc.usace.army.mil

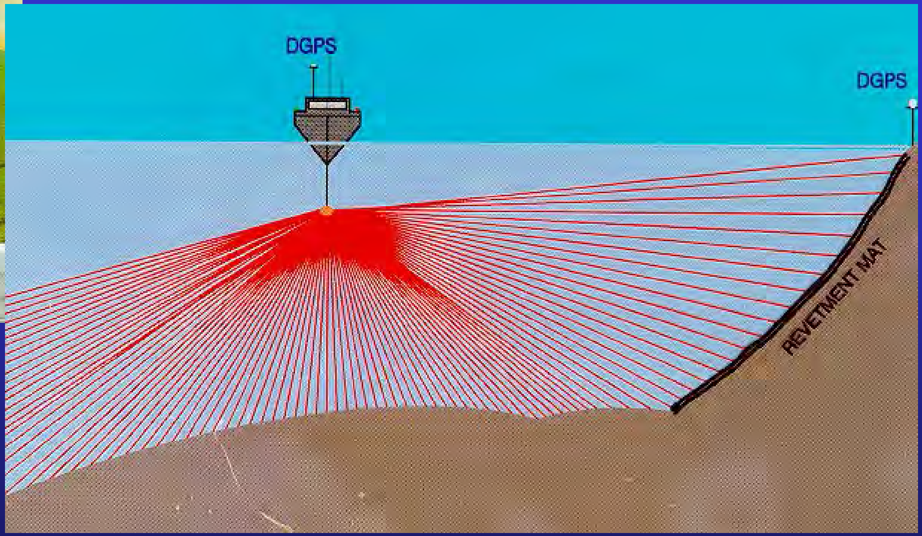

High Resolution Bathymetry and Fly-Through Visualization
Paul Clouse
Lockheed Martin / U.S. Army Corps of Engineers

Why Visualize?

- See scour and accretion patterns
- See structures
- Determine hazards
- Examine habitat
- Differentiate bottom type (hard vs. soft)
- Added value to survey
- View surveys in unprecedented details from virtually any angle

Bathymetry

- The measurement of depths of a body of water



Bathymetric Data Collection

- Data is collected in an X Y Z format
- Produces a copious amount of data points
- Several million points per river mile
- 1 million dimes placed end to end would stretch over 11 miles!
- 1 million dimes stacked on top of each other would be over 1/2 mile tall!

St. Louis District's High Resolution Surveying Vessels

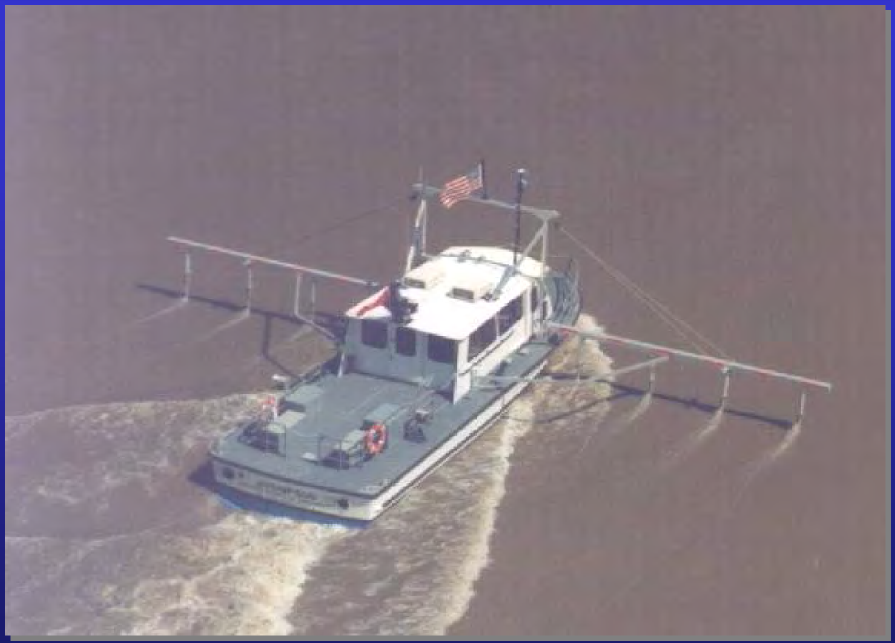
US Army Corps of Engineers

M/V Boyer

Multi-beam

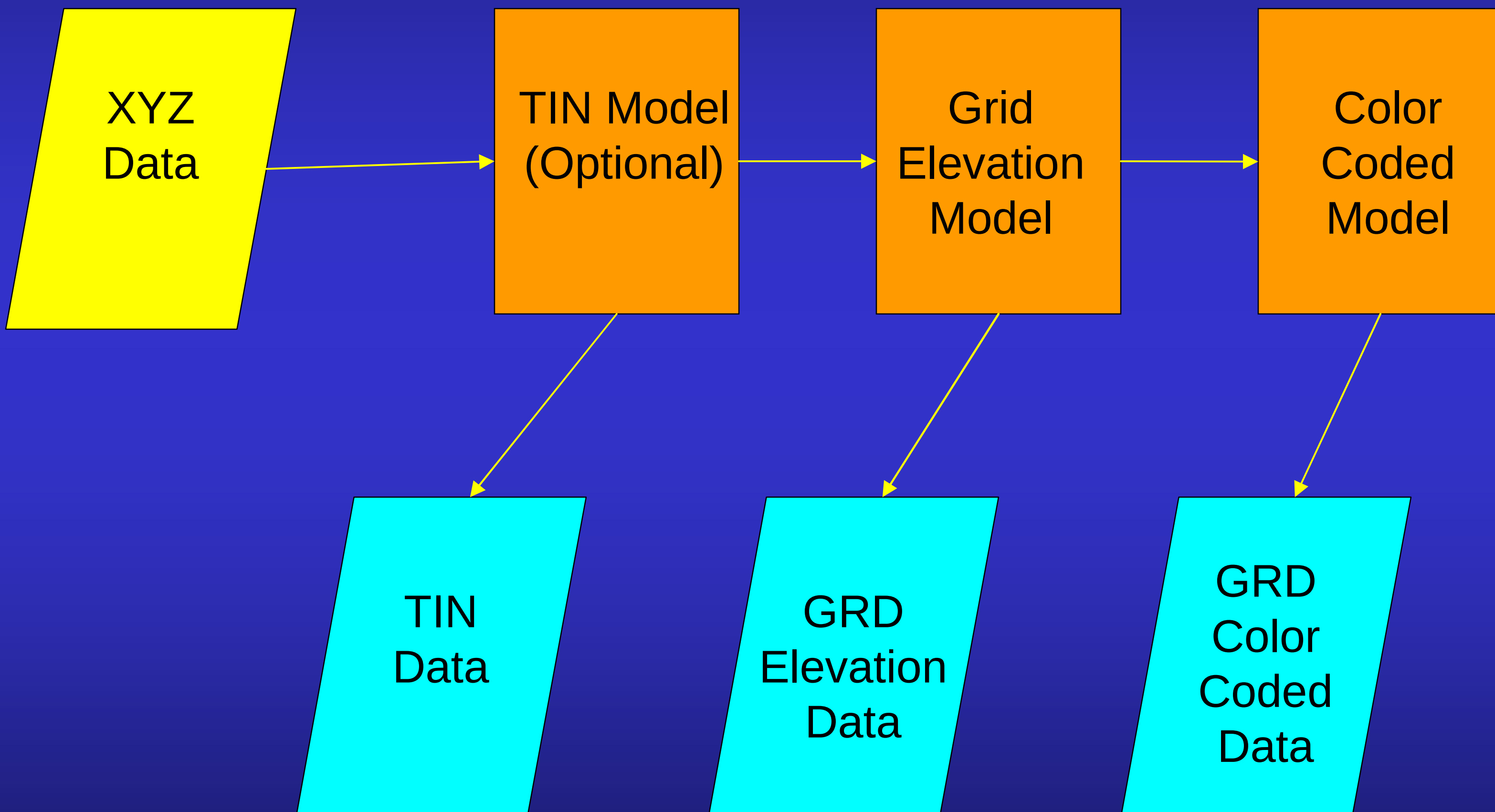
M/V Simpson

Multi-transducer

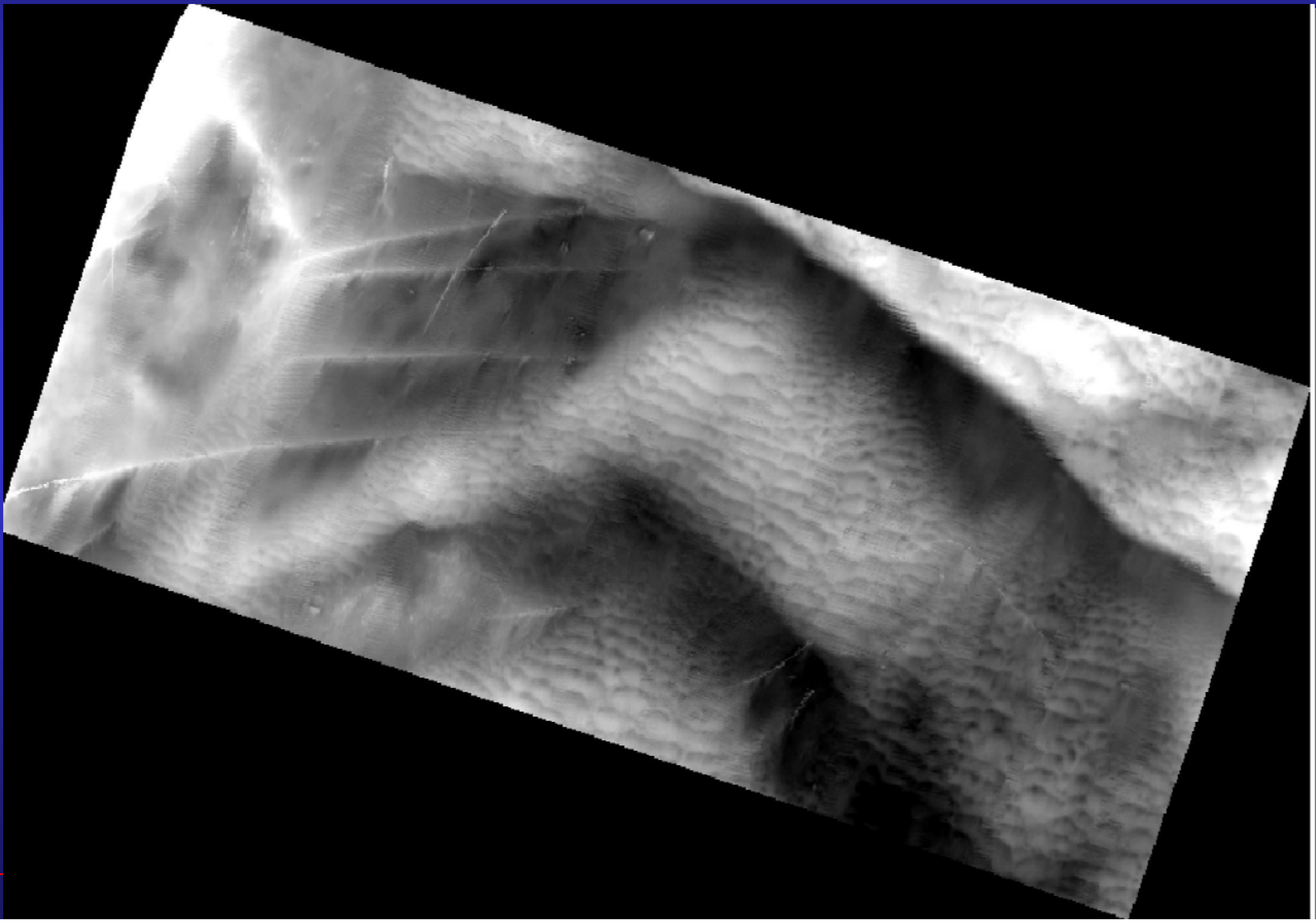


US Army Corps of Engineers

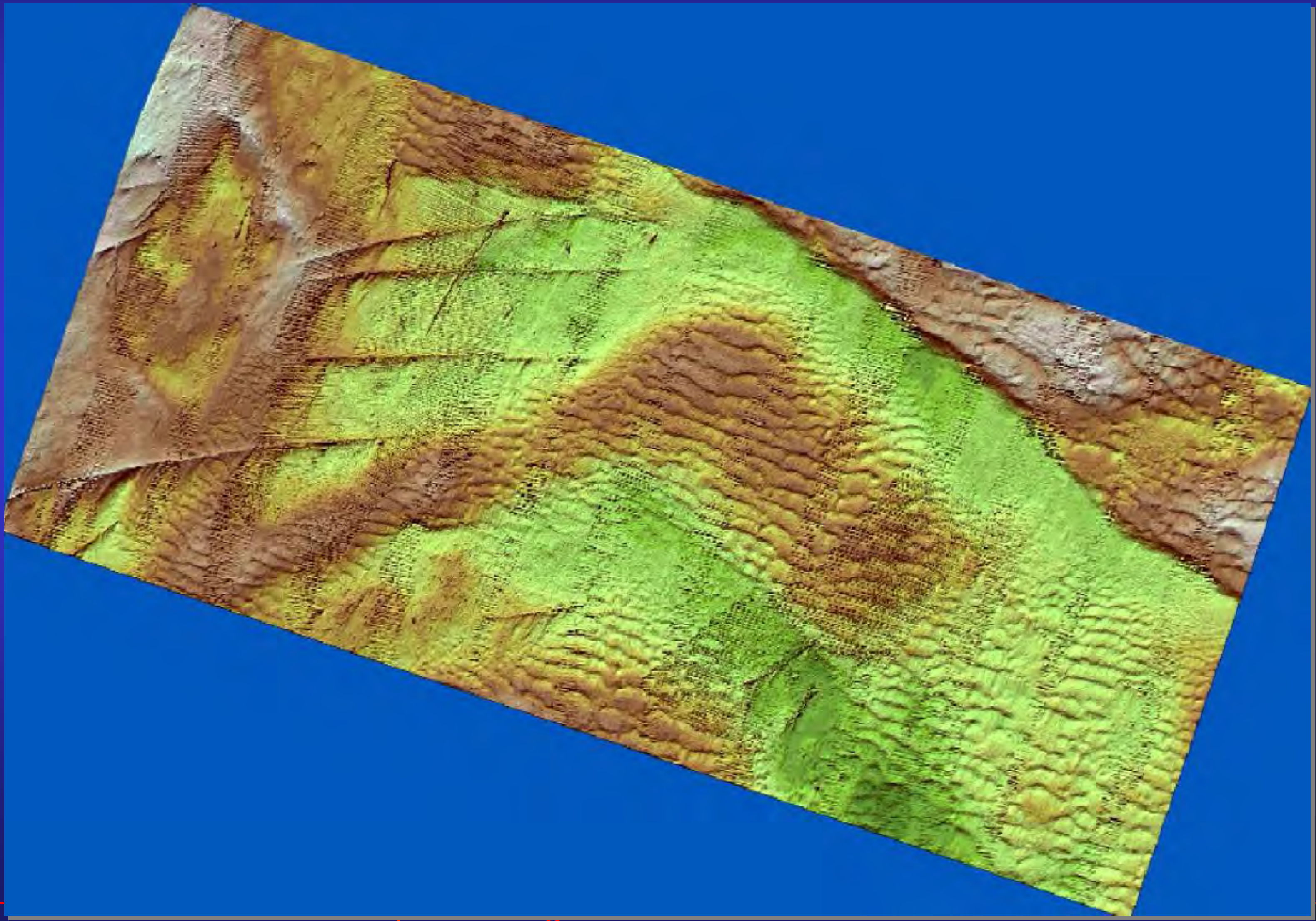
Bathymetric Modeling



Grid Model



Color Coded Model



Methods for Visualization

- Static Fly Through
- Interactive

US Army Corps of Engineers

Visualization Workflow

- Setup the scene
- Setup up the flight
- Record the flight

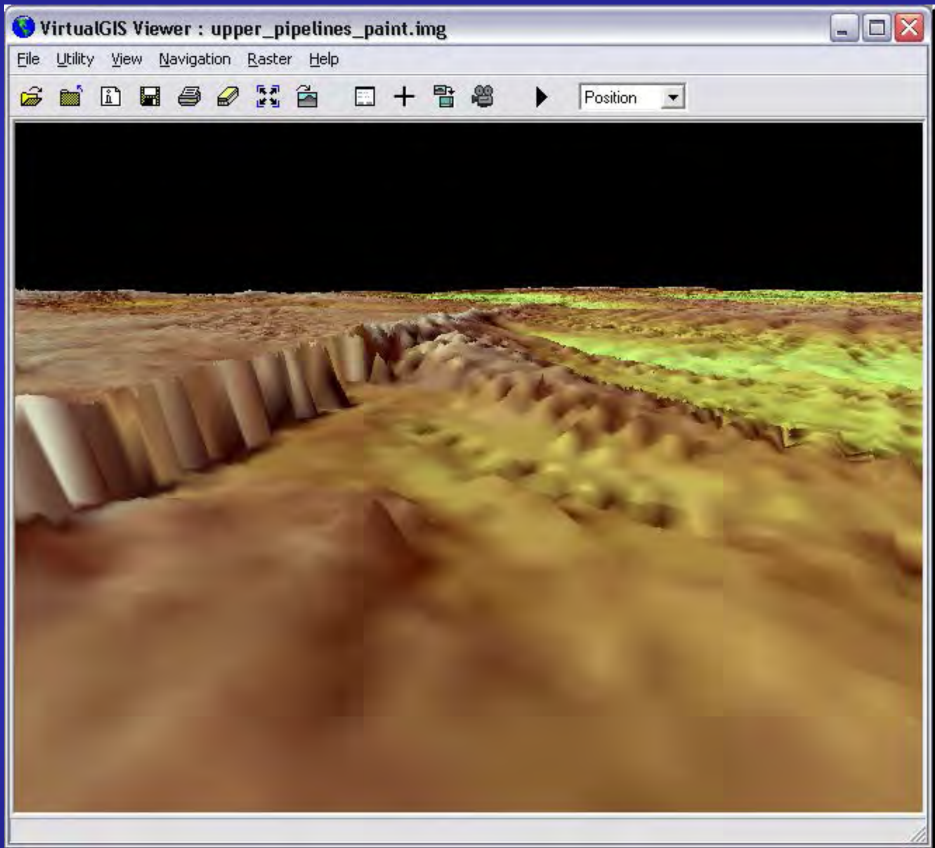
US Army Corps of Engineers

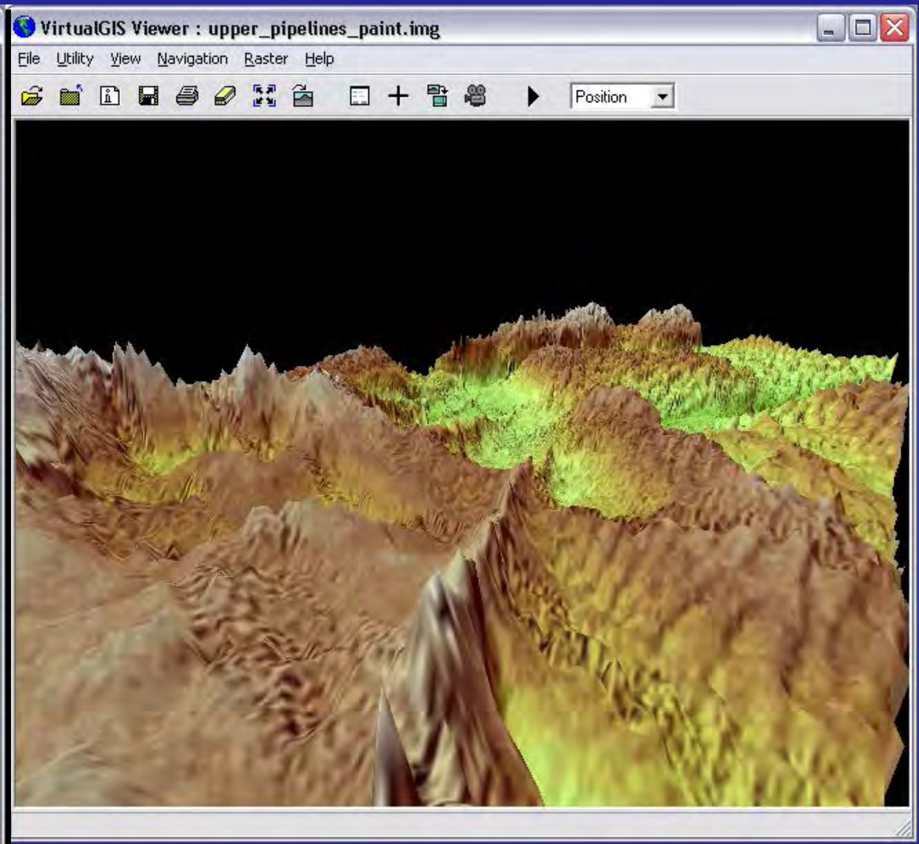
Scene Properties

- Vertical Exaggeration
- Sun Elevation
- Sun Azimuth

Scene Properties
Vertical Exaggeration

US Army Corps of Engineers



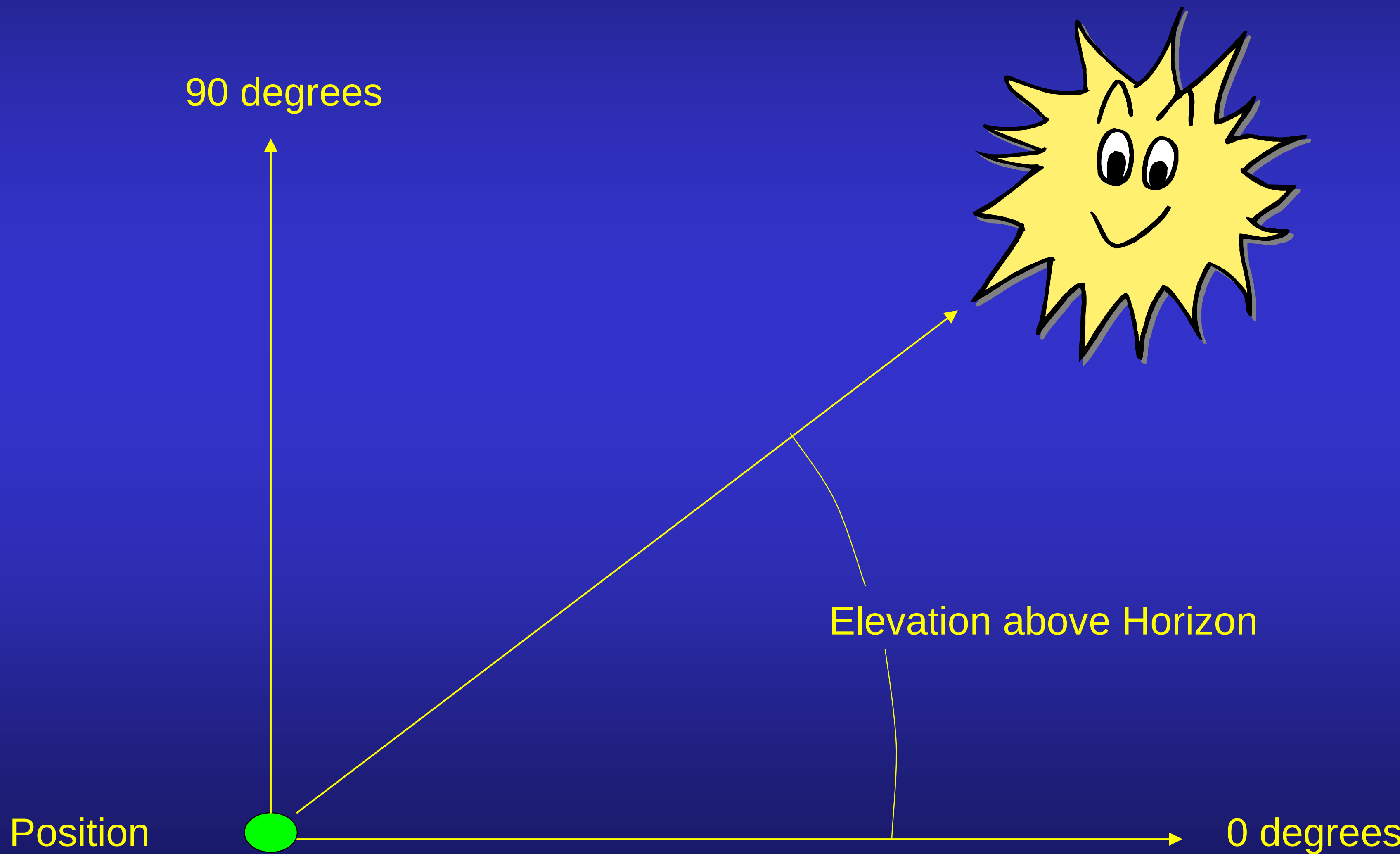


Normal

10x Exaggeration

Scene Properties

Sun Positioning – Elevation



One Corps Serving the Armed Forces and the Nation

Scene Properties
Sun Positioning – Azimuth

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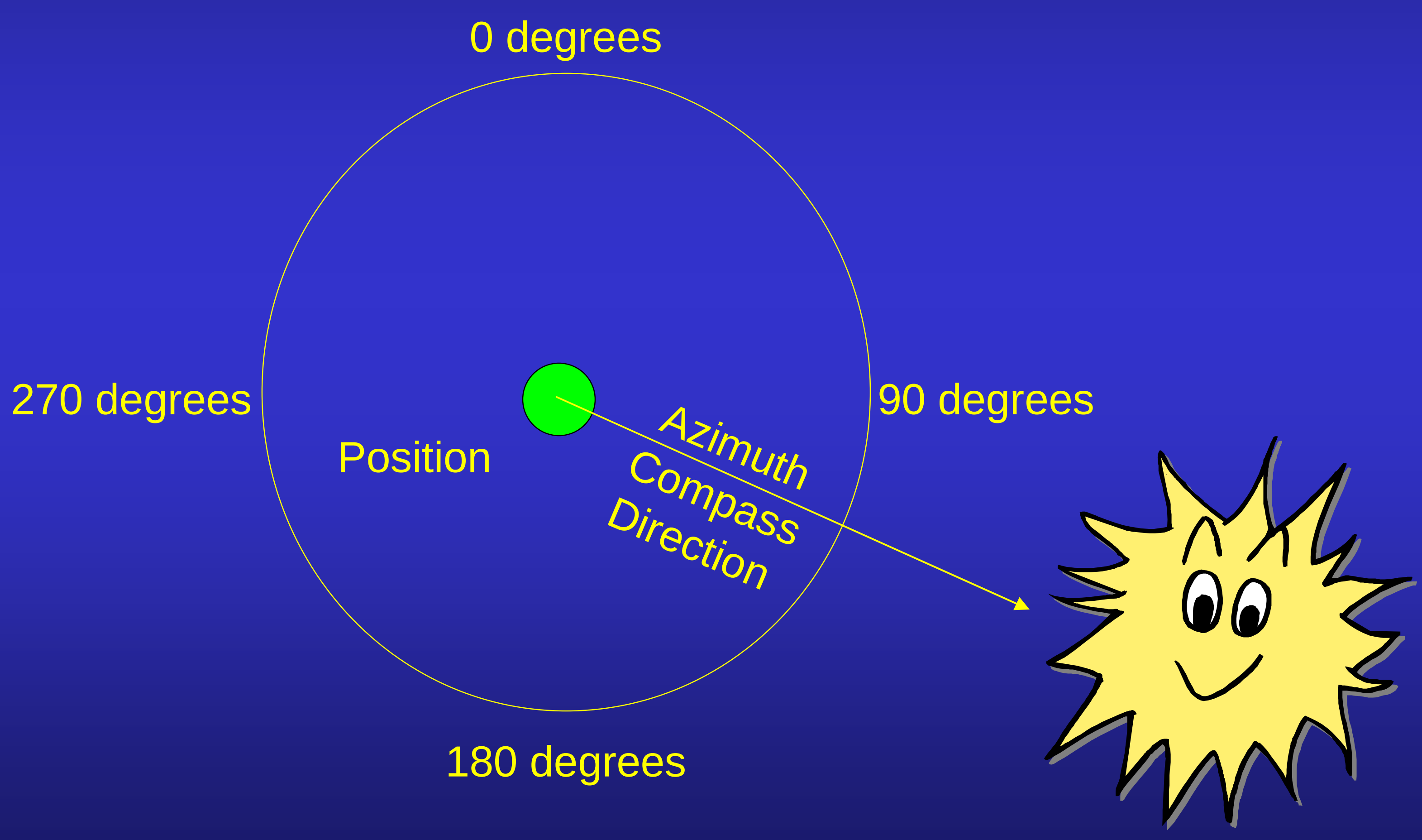
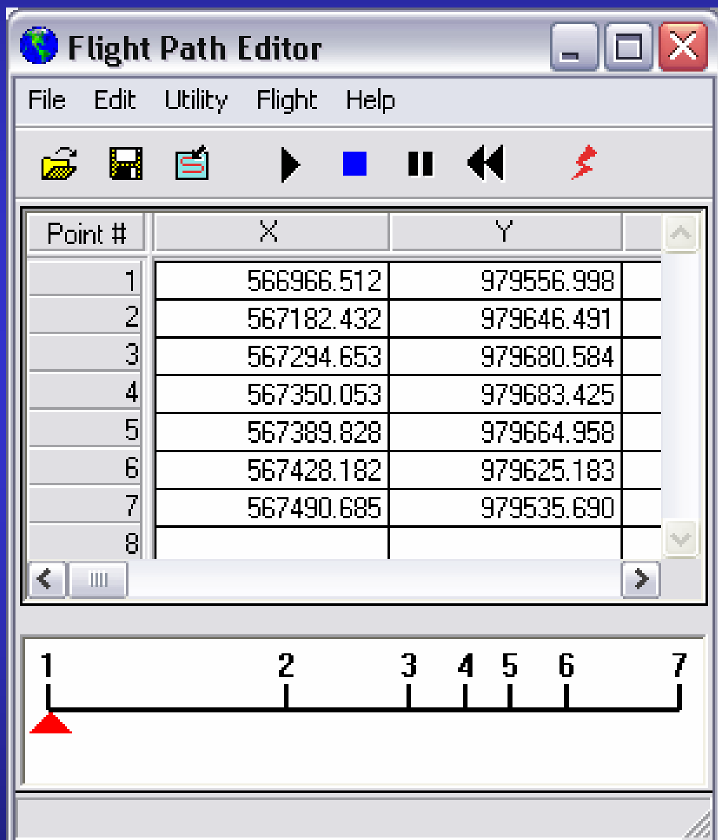


Flight Properties

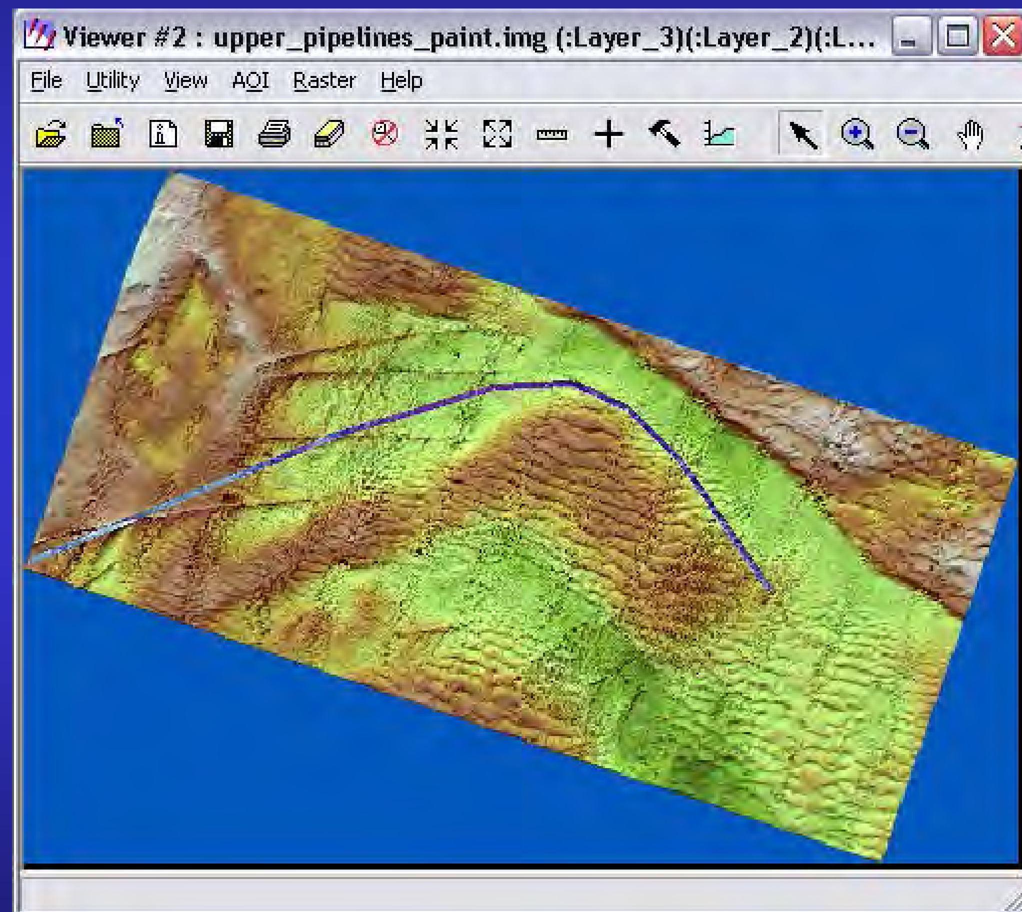
- Flight Path
- ASL & AGL
- Look Azimuth
- Look Pitch
- Field of View
- Roll
- Speed

US Army Corps of Engineers

Flight Properties
Flight Path

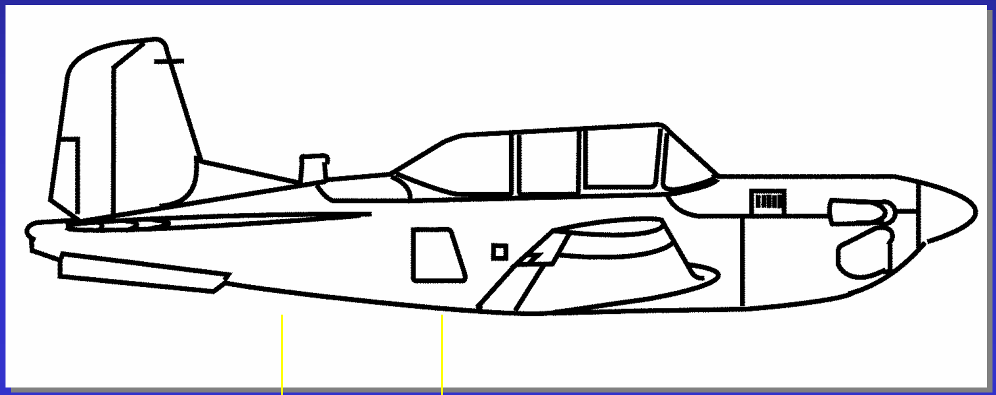


Key in X Y Coordinates



Digitize

Flight Properties
ASL & AGL

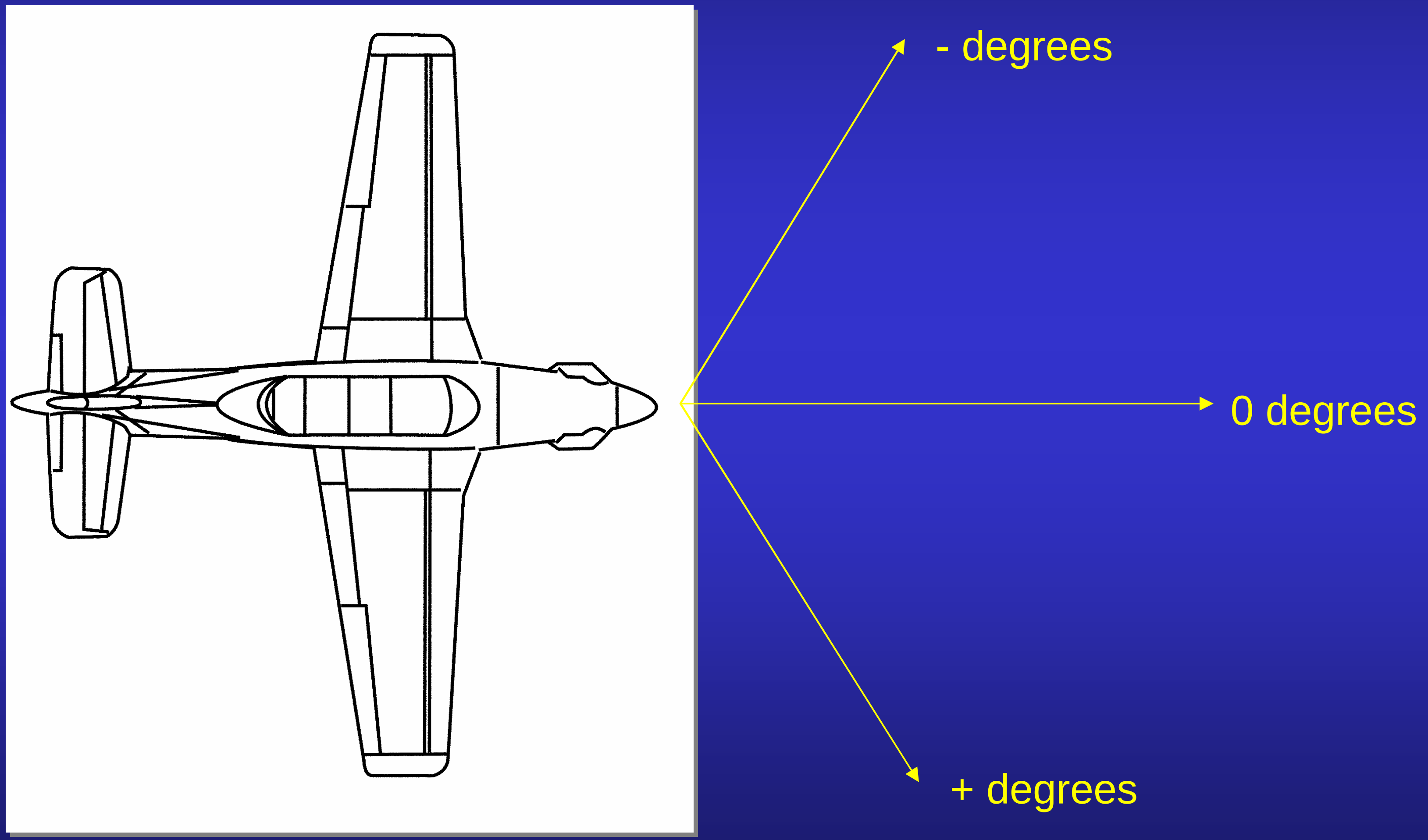


Elevation Above Ground Level

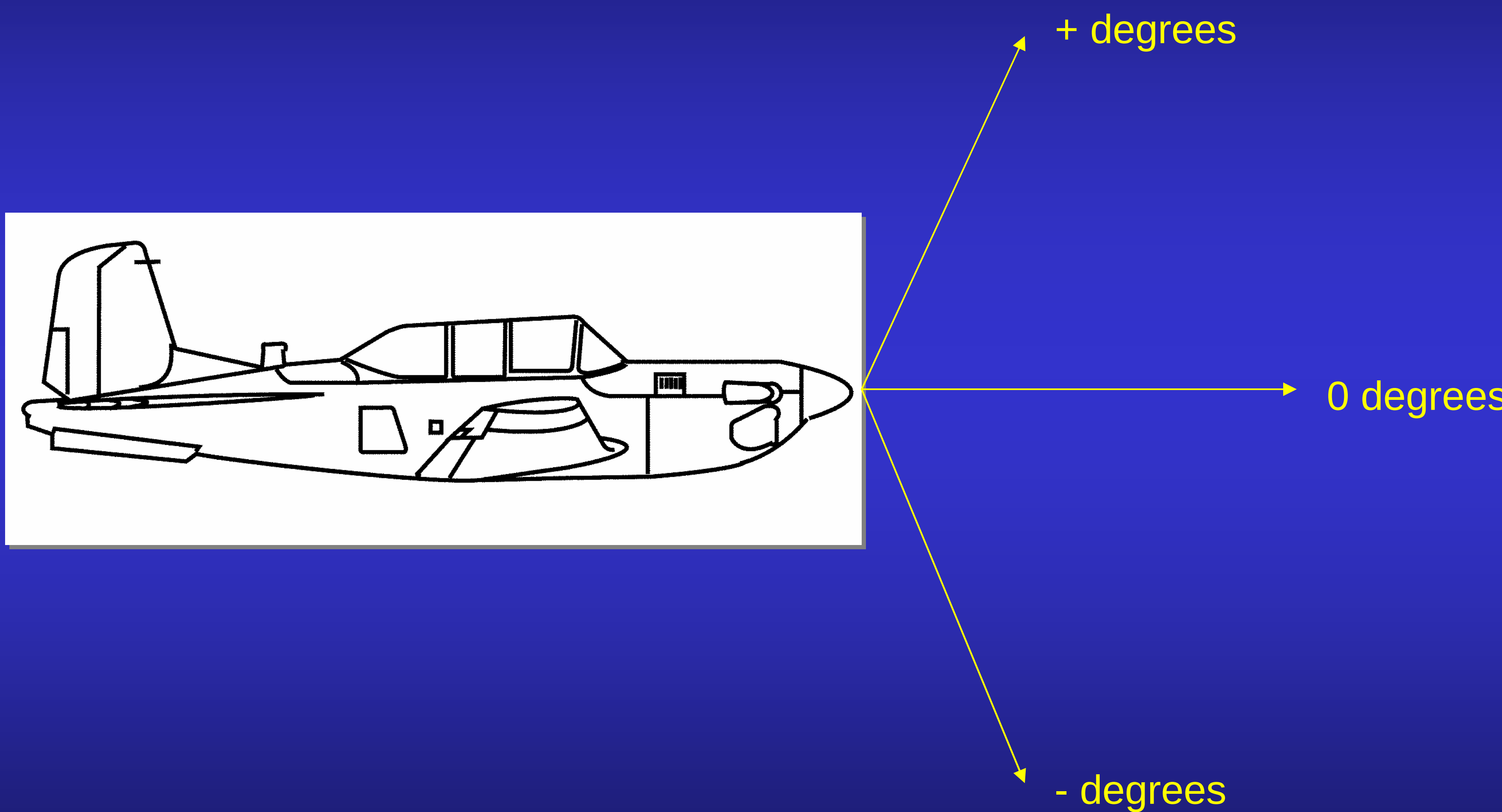
Elevation Above Sea Level

US Army Corps of Engineers

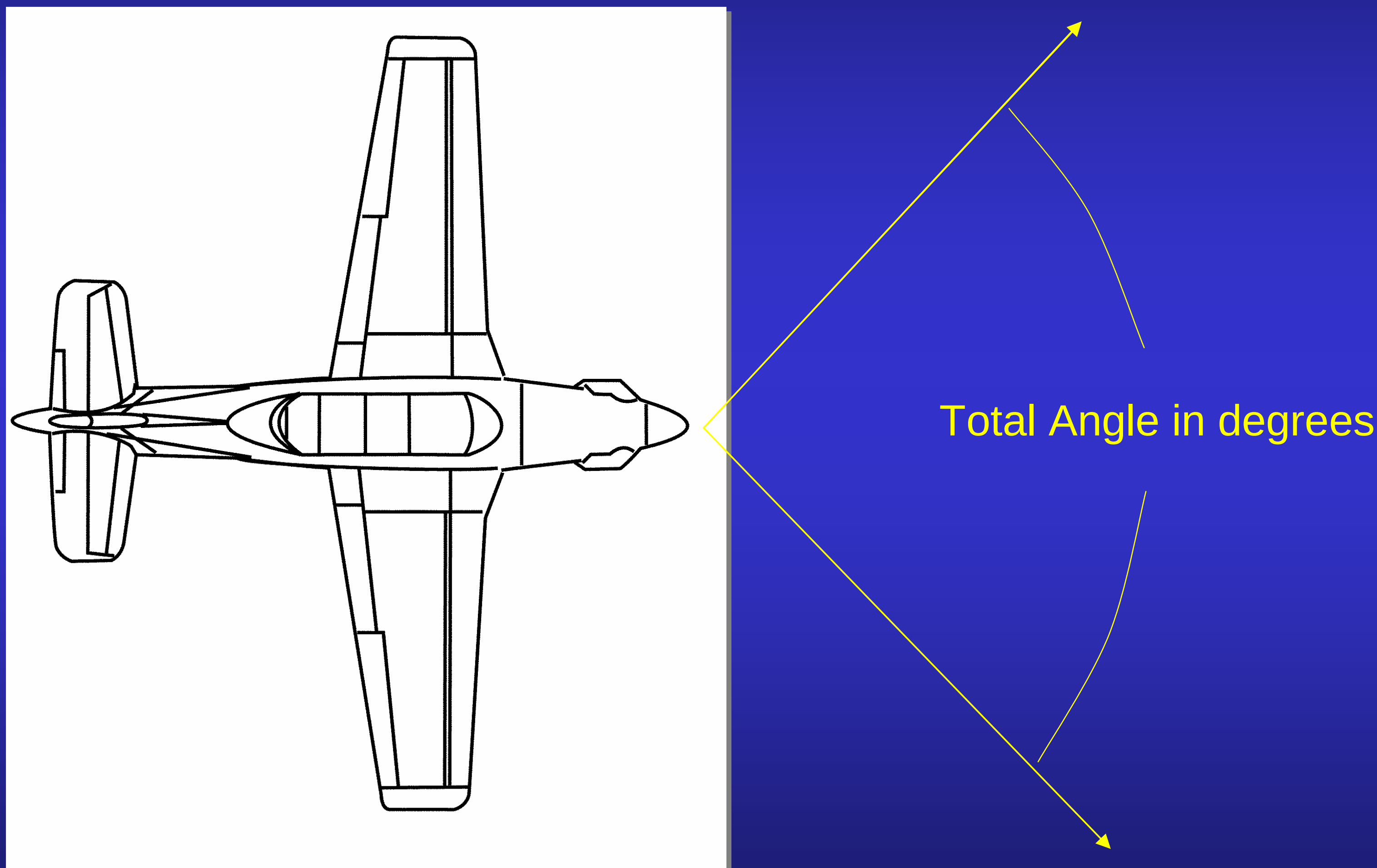
Flight Properties
Look Azimuth



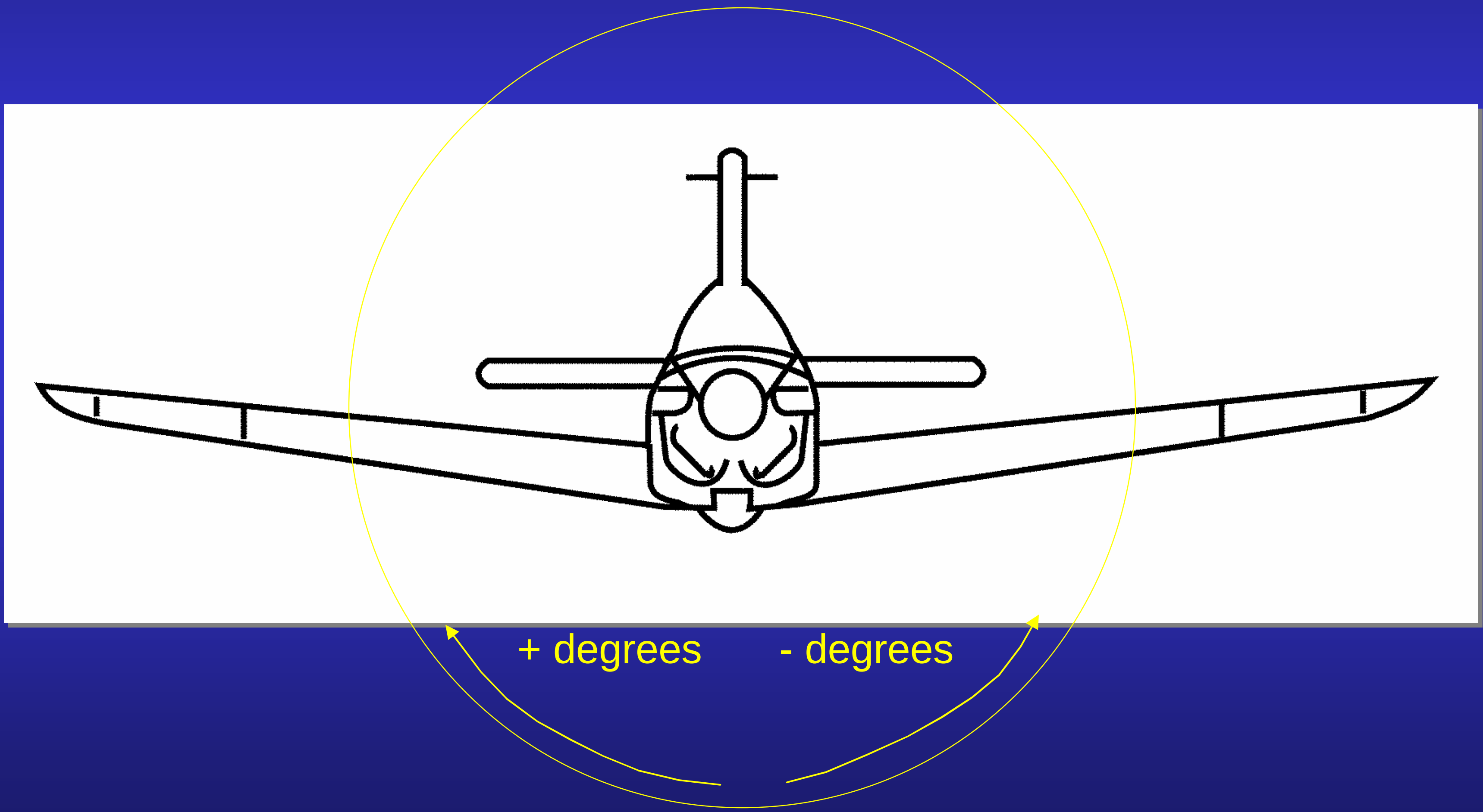
Flight Properties
Look Pitch



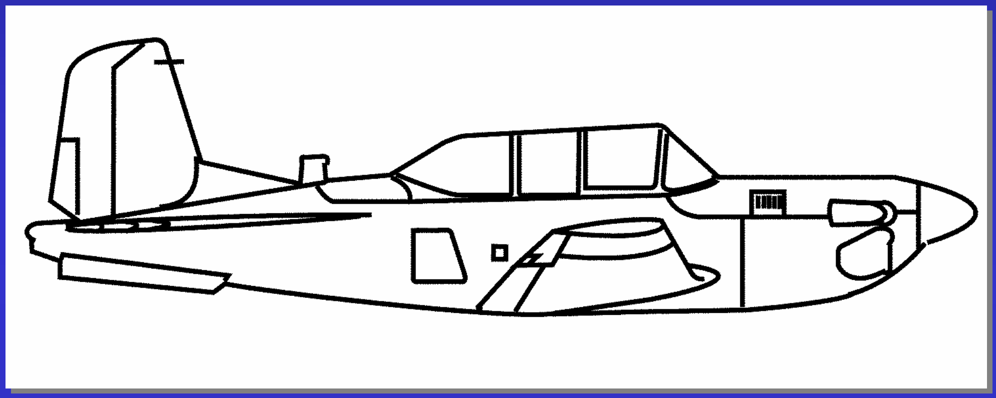
Flight Properties
Field of View



Flight Properties
Roll



Flight Properties
Speed



Motion

US Army Corps of Engineers

Completed Flight Properties

Flight Path Editor

File Edit Utility Flight Help

Point #	X	Y	ASL	AGL	Look Azimuth	Look Pitch	FOV	Roll	Speed
1	2197868.8371	282214.014	645.00	20.63	60.00	-35.00	90.00	0.00	0.30
2	2197888.128	281911.788	645.00	25.63	60.00	-35.00	90.00	0.00	0.30
3	2197894.558	281812.117	645.00	25.42	60.00	-35.00	90.00	0.00	0.30
4	2197904.204	281670.650	645.00	21.20	60.00	-35.00	90.00	0.00	0.30
5	2197910.634	281574.195	645.00	17.09	60.00	-35.00	90.00	0.00	0.30
6	2197923.495	281464.879	645.00	16.81	60.00	-35.00	90.00	0.00	0.30
7	2197933.141	281352.348	645.00	14.72	60.00	-35.00	90.00	0.00	0.30
8	2197946.001	281249.462	645.00	17.05	60.00	-35.00	90.00	0.00	0.30
9	2197949.216	281156.222	645.00	17.69	60.00	-35.00	90.00	0.00	0.30
10	2197949.216	281069.412	645.00	16.66	60.00	-35.00	90.00	0.00	0.30
11	2197936.356	280989.033	645.00	15.76	60.00	-35.00	90.00	0.00	0.30
12	2197884.913	280960.096	645.00	15.82	60.00	-35.00	90.00	0.00	0.30
13	2197823.825	280982.602	645.00	15.63	60.00	-35.00	90.00	0.00	0.30
14	2197759.521	281072.627	645.00	14.91	90.00	-35.00	90.00	0.00	0.30
15	2197749.876	281143.361	645.00	17.90	60.00	-35.00	90.00	0.00	0.30
16	2197743.445	281249.462	645.00	19.15	60.00	-35.00	90.00	0.00	0.30
17	2197733.800	281358.778	645.00	14.89	60.00	-35.00	90.00	0.00	0.30
18	2197720.939	281458.448	645.00	18.91	60.00	-35.00	90.00	0.00	0.30
19	2197708.078	281596.701	645.00	16.46	60.00	-35.00	90.00	0.00	0.30
20	2197701.648	281696.371	645.00	18.30	60.00	-35.00	90.00	0.00	0.30
21	2197688.787	281824.978	645.00	27.68	60.00	-35.00	90.00	0.00	0.30
22	2197692.002	281915.003	645.00	25.94	60.00	-35.00	90.00	0.00	0.30
23	2197692.002	282133.635	645.00	24.98	150.00	-60.00	90.00	0.00	0.30
24									

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Recording a Flight

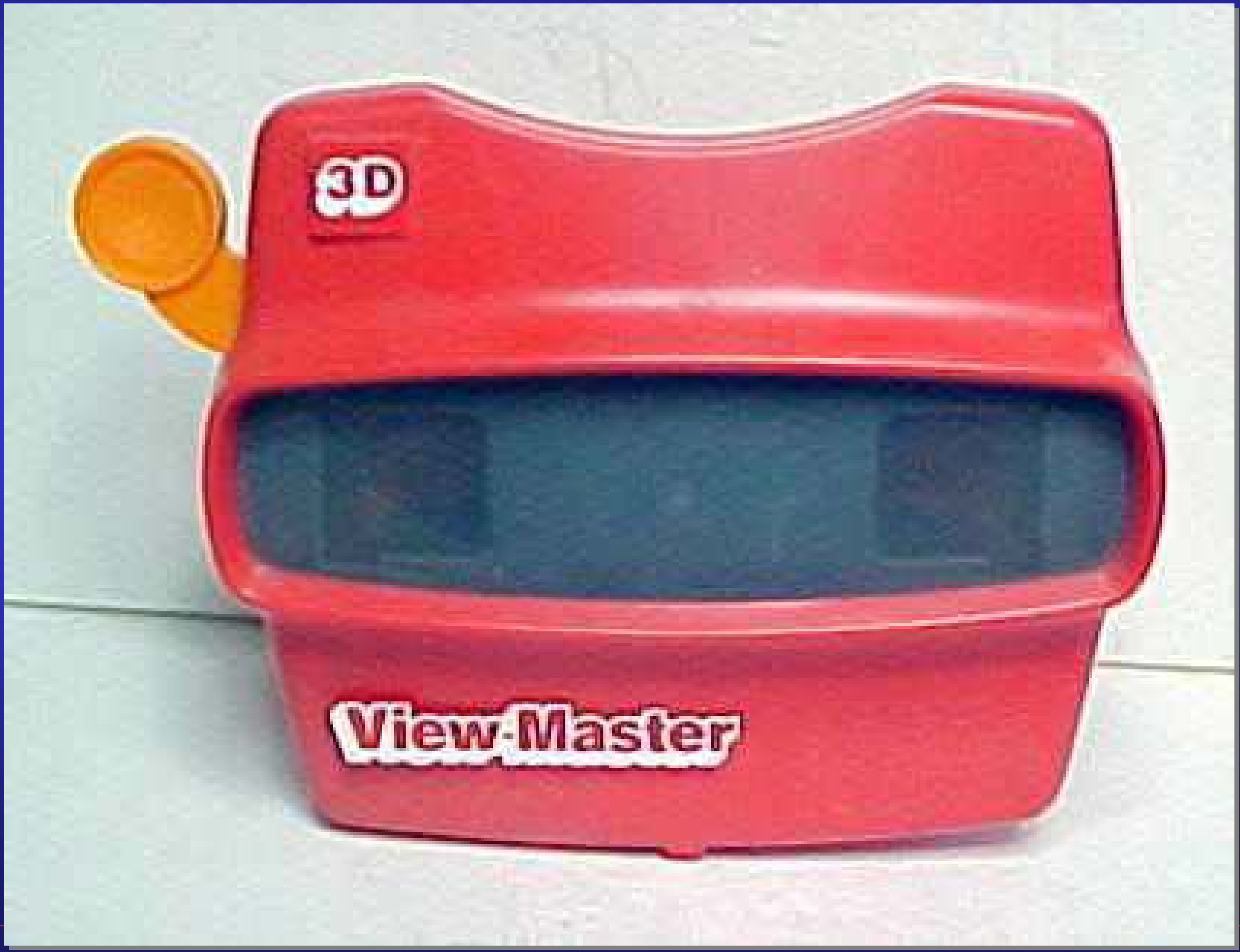
- Set the output movie type i.e. mpg or avi
- Set the output file
- Begin the flight

Anaglyph

- A moving or still picture consisting of two slightly different perspectives of the same subject in contrasting colors that are superimposed on each other, producing a three dimensional effect when viewed through two correspondingly colored filters.

US Army Corps of Engineers

Anaglyphs are Child's Play



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Warning: Some visualizations may make you dizzy or cause headaches and nausea

If you experience symptoms, please remove your anaglyph glasses and close your eyes

US Army Corps
of Engineers

Anaglyph Test

Can you see 3D?

Hint: The top coin should be floating above the bottom coin


Photo
Opportunity

US Army Corps of Engineers

Learning to Fly

The Movie

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Questions??

One Corps Serving the Armed Forces and the Nation

US Army Corps of Engineers

Contact Information

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Lockheed Martin \ U.S. Army Corps of Engineers

Paul.Clouse@usace.army.mil

Fern Ridge Lake Hydrologic Aspects of Operation during Failure

Presented by Bruce J Duffe, PE

CENWP-EC-HY

03 August 2005
St Louis, MO

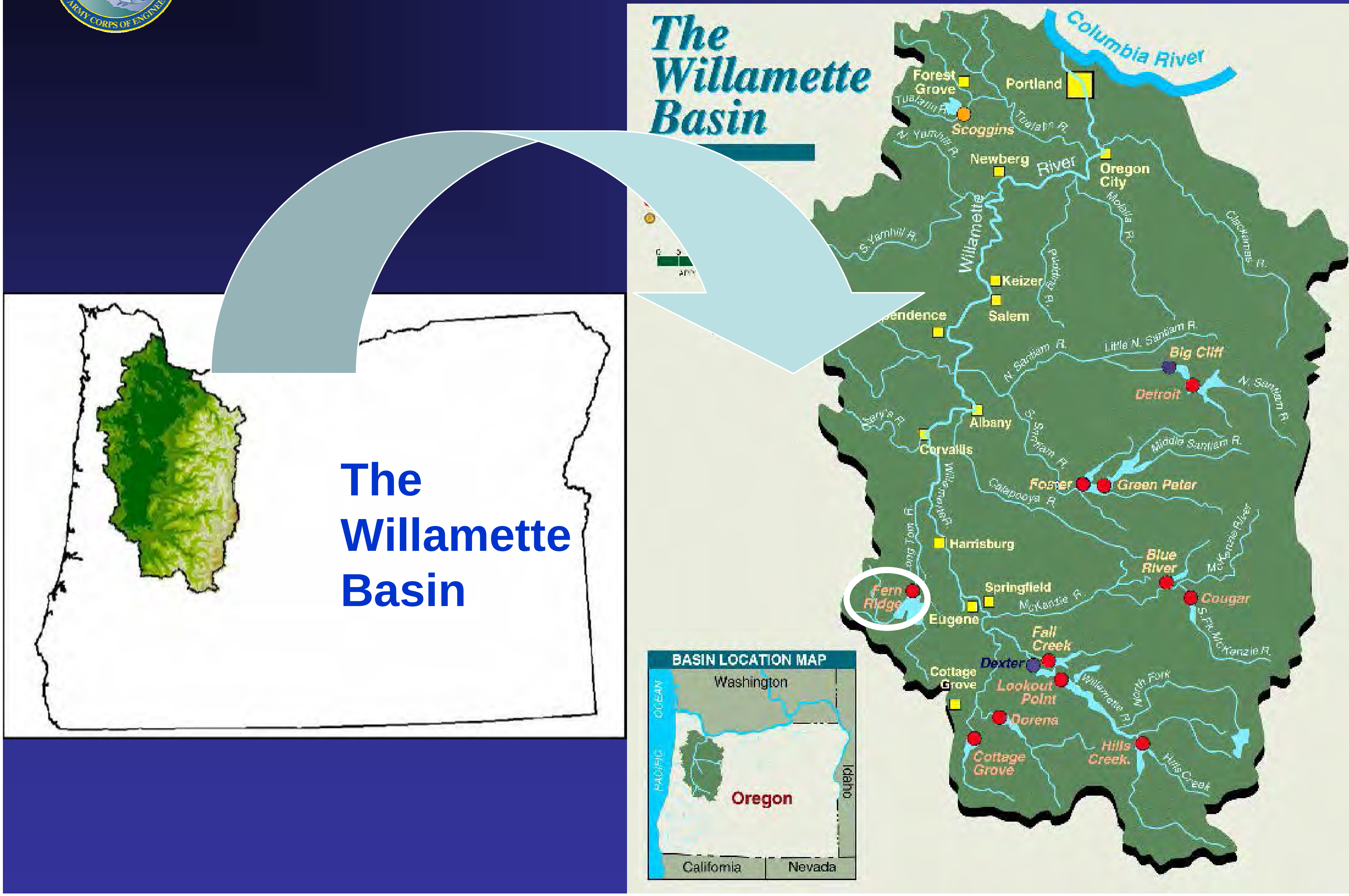
Fern Ridge Lake

- Oldest Corps Dam in the Willamette Basin
  - Completed in 1942
  - Raised in 1965
- Multipurpose Project; uses shared storage
- Current Authorized Uses:
  - Flood Control, Irrigation, Low Flow Regulation
- Regular Periodic Inspections – drainage problems noted
- Standard maintenance requirements (old)

Fern Ridge Lake

- Dam Safety General Issues
  - Seismic Deficiency
  - Hydrologic Deficiency
  - Embankment Drain Failure
- Follow the Time Line of the Failure
  - July 2002 to Present
- General information; hitting high points

Fern Ridge Lake



Fern Ridge Lake

- **Watershed (square miles)** 275
- **Crest Elevation (ft)** 381.5
- **Crest Length (ft)** 6,610
- **Reservoir Pool (acre-ft)**
  - Max FC Pool Storage, EL 375.1 111,400
  - Max Conservation Storage, EL 373.5 97,300
  - Inactive Storage, EL 353.0 2,800
- **Spillway**
  - Six 34’ wide x 18’ high Tainter Gates EL 358.5
  - Maximum Discharge (ft^3/s) 47,200
- **Outlet**
  - Four 6.75’ x 9.75’ Sliding Gates
  - One 3’ x 3’ Sluice Gate
  - Design Discharge at Max FC Pool (ft^3/s) 8,440

Fern Ridge Dam and Reservoir

Outlet Works

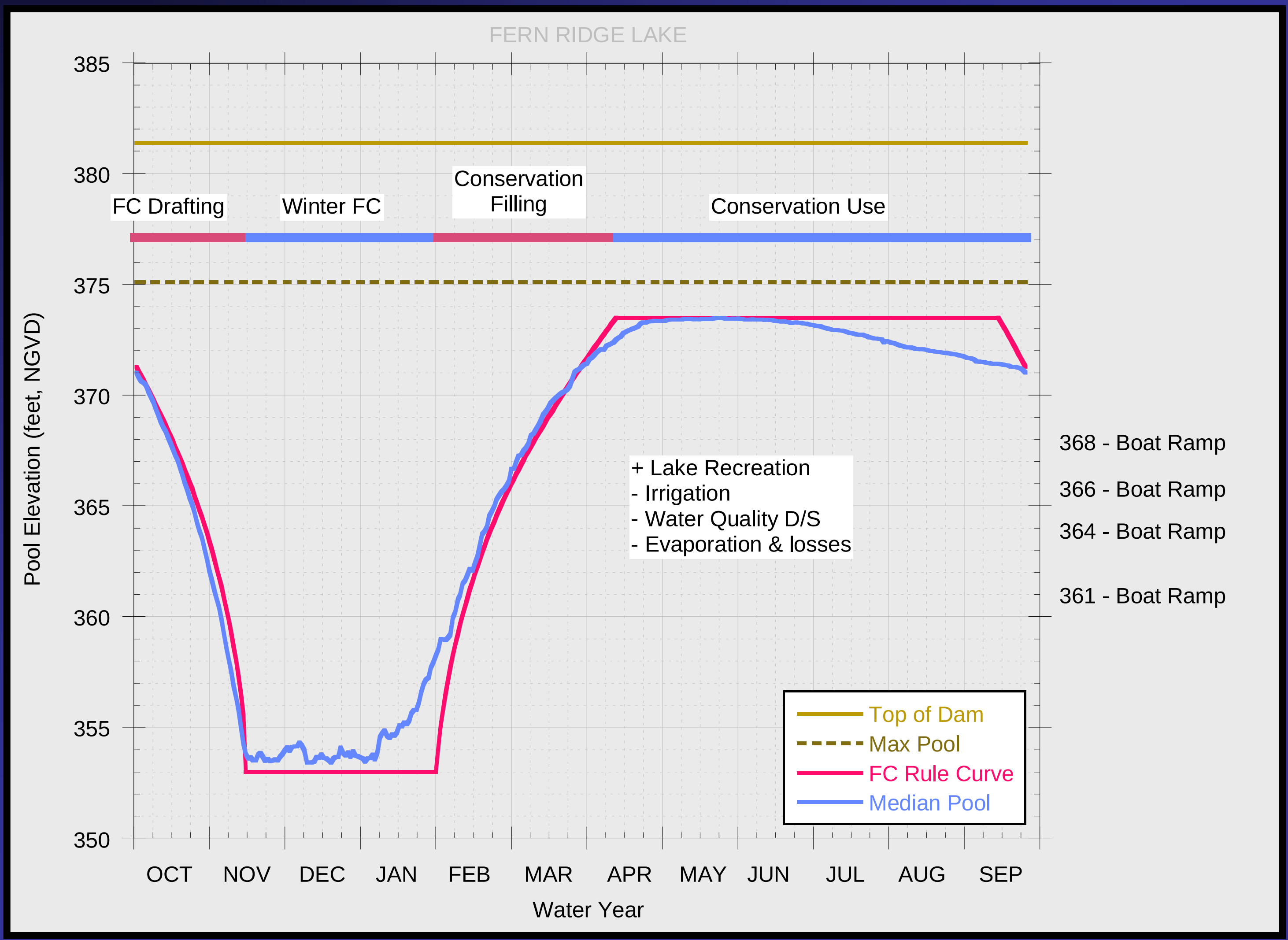
Project Overview

Looking east along upstream face of spillway towards right wing wall

Project Overview

Tailrace from right bridge abutment (230 cfs)

Typical Operation



July 2002 – The Start

- All had been well…
- Embankment Depression
  - Spotted by Maintenance Crew
  - First real indication
- No recent abnormal flows or operations

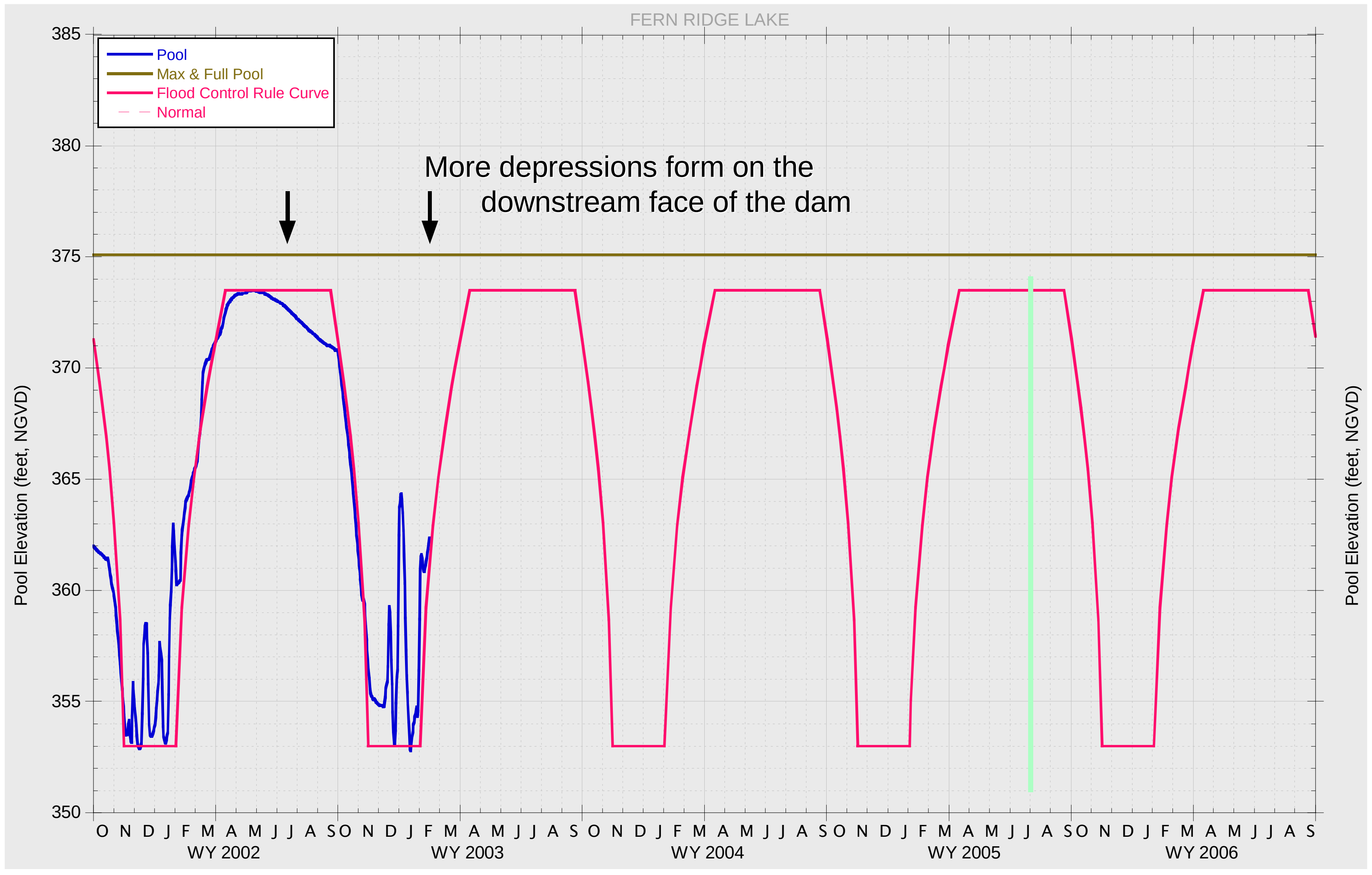
July 2002

FERN RIDGE LAKE
Pool
Max & Full Pool
Flood Control Rule Curve
Normal
Operators observed a depression on the downstream face of the dam
Pool Elevation (feet, NGVD)
385
380
375
370
365
360
355
350
O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
WY 2002
WY 2003
WY 2004
WY 2005
WY 2006

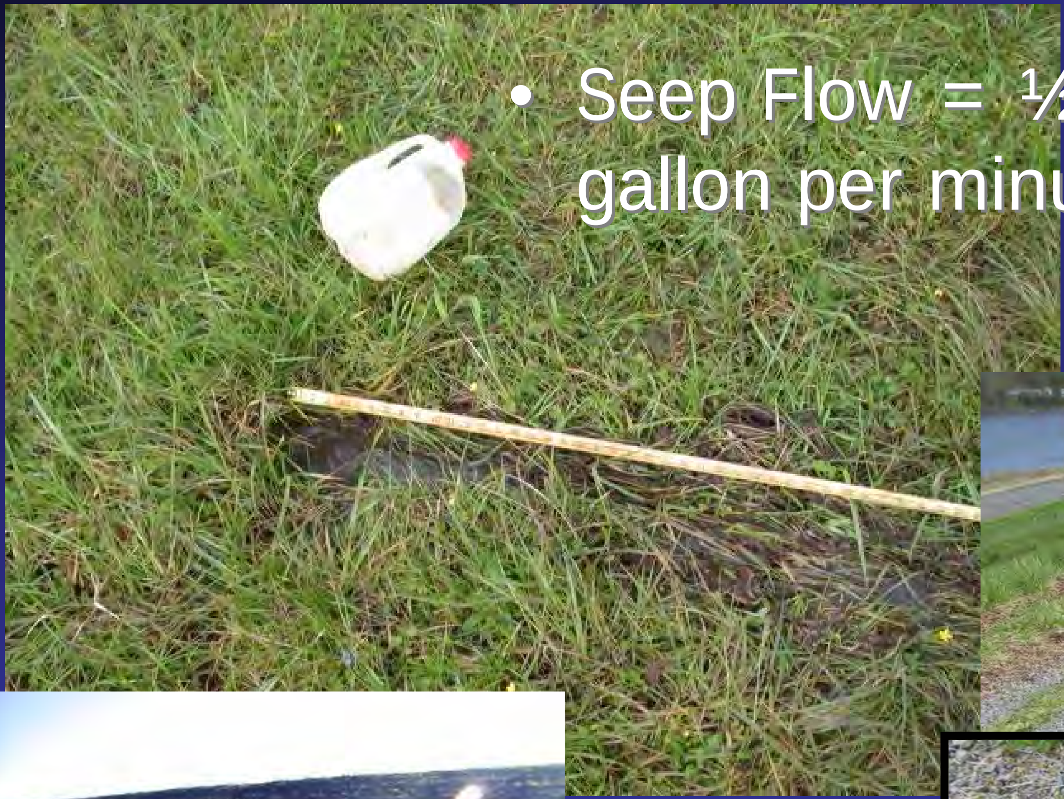
Calcification Inside Drain

- Video Inspection
  Rover

February 2003 - Conundrum



Seeps & Sinks

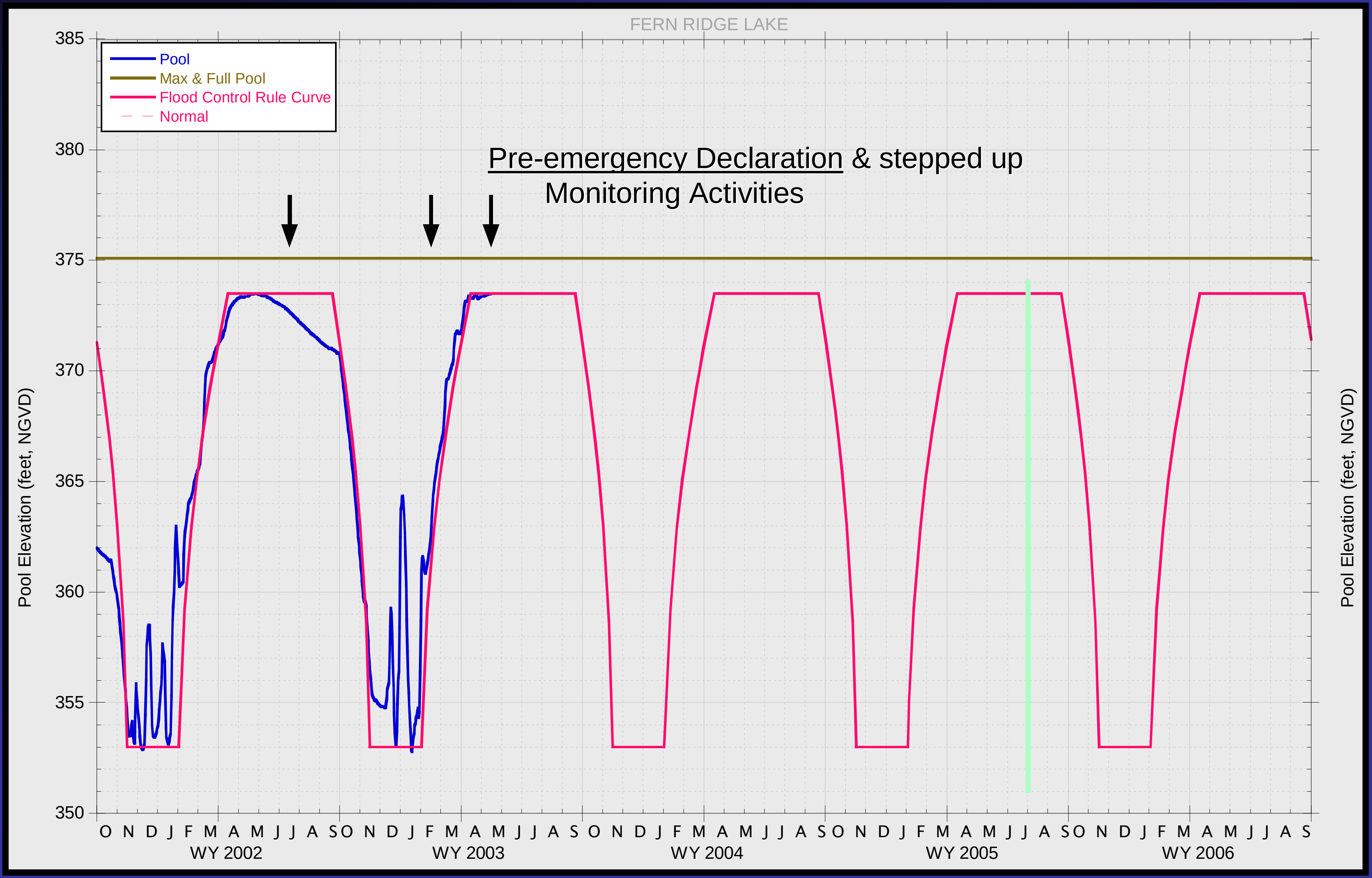


- Seep Flow = ½ gallon per minute

February 2003

Drain System

May 2003


FERN RIDGE LAKE
Pool
Max & Full Pool
Flood Control Rule Curve
Normal
Pre-emergency Declaration & stepped up
Monitoring Activities
385
380
375
370
365
360
355
350
Pool Elevation (feet, NGVD)
O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
WY 2002
WY 2003
WY 2004
WY 2005
WY 2006
Pool Elevation (feet, NGVD)

Monitoring

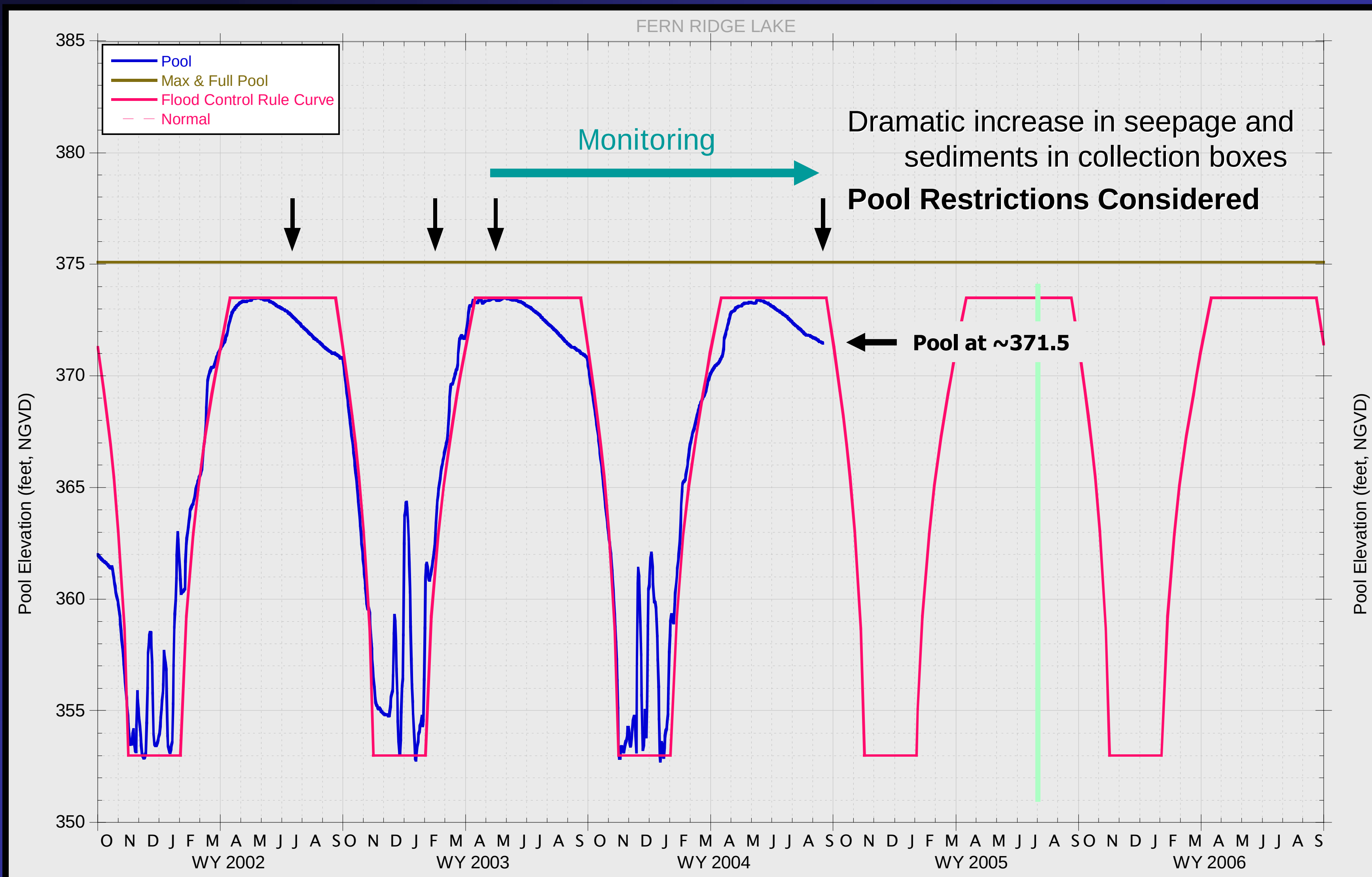
- June 2003 – August 2004
  - Started gathering operational and hydrologic information
  - Field investigation (drilling, sampling, lab work); redoubled monitoring; sediment sampling; automation of equipment completed sprinkler test, test pits; etc.
  - Looked for funding methods/support
- No big changes until August
  - Dramatic increases in drainage discharge & sediment accumulation in weir boxes

August 2004

Debris collected from Station 22+00

Sediment accumulated in Station 45+00 weir box

Monitoring - May 03…Aug 04

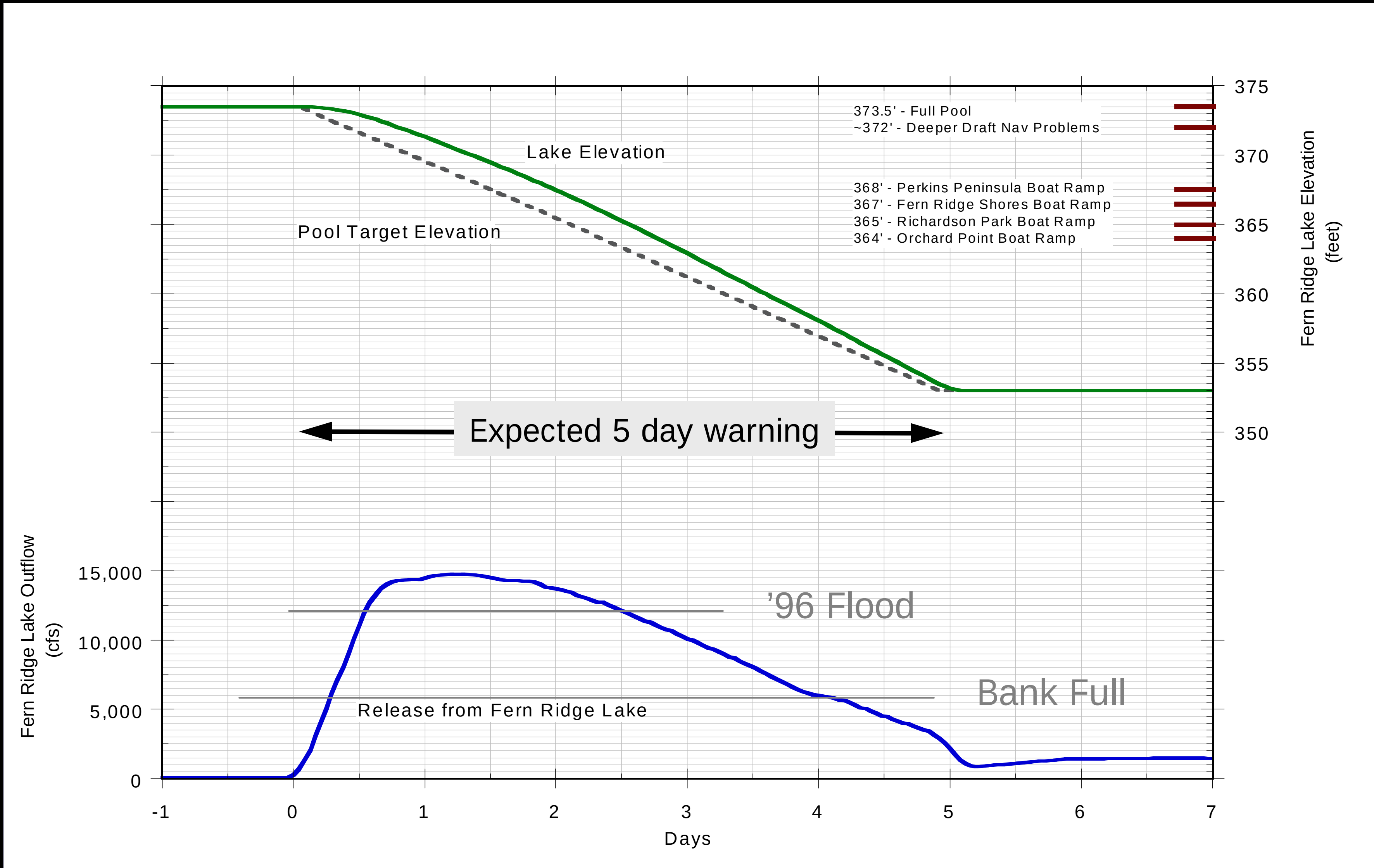


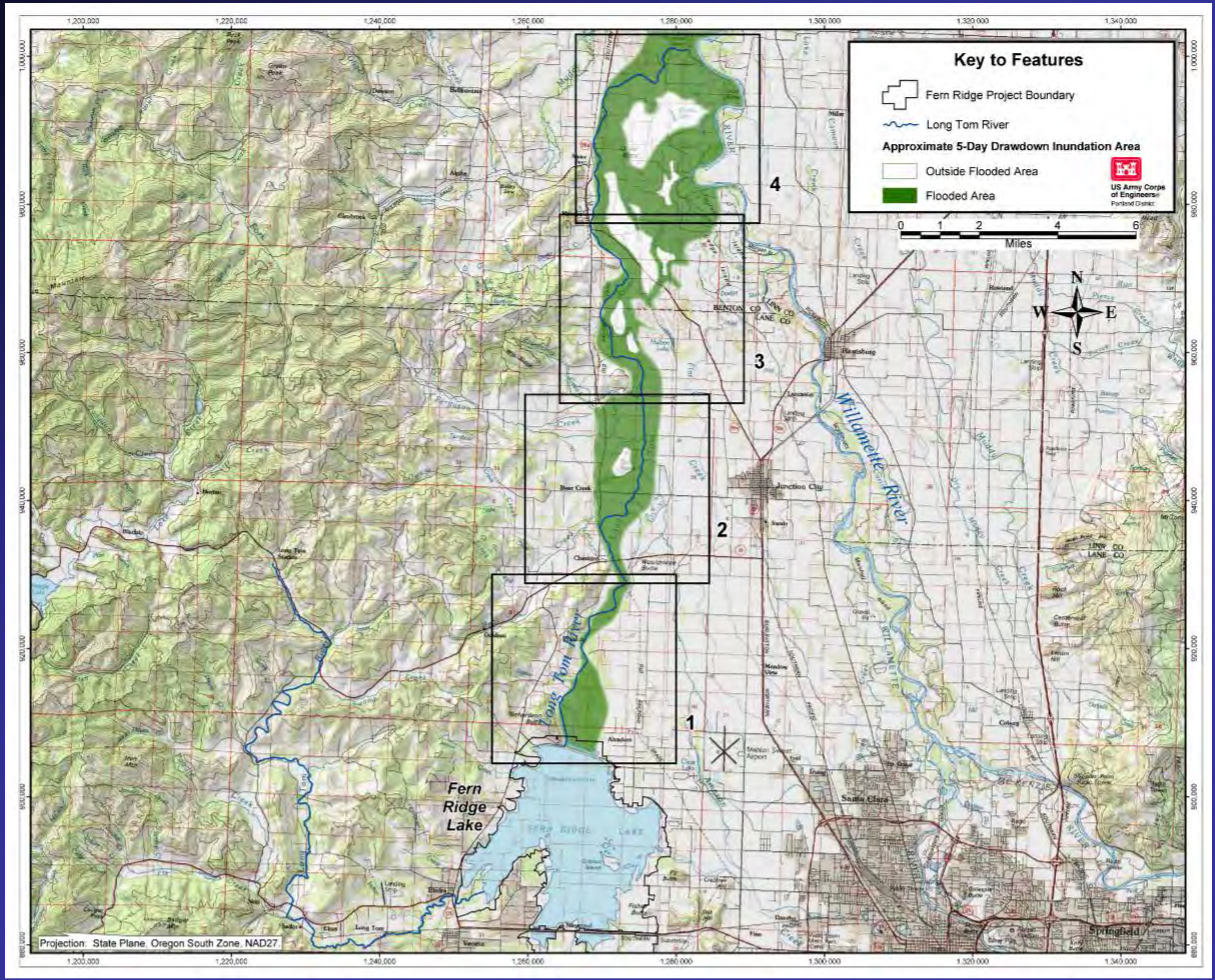
NWP Proposed Restriction

- In effect from 1 October to 1 May
- Maximum pool to be 371 ft
- Does Not Eliminate Possible Need for a Rapid Drawdown of the Reservoir

- Small Risk of Additional Flooding (<5%)
- Impacts to Deep Draft Recreational Users (a shorter season)
- Numerous scenarios evaluated

Emergency Drawdown?




Key to Features
Fern Ridge Project Boundary
Long Tom River
Approximate 5-Day Drawdown Inundation Area
Outside Flooded Area
Flooded Area
US Army Corps of Engineers
Portland District
Miles
Fern Ridge Lake
Long Tom River
Willamette River
Junction City
Harrisburg
Springfield
Santa Clara
Projection: State Plane, Oregon South Zone, NAD27
1
2
3
4

Direction

- September/October 2004
  - NWP / NWD / HQ
  - Dam Safety Assurance Study/Funding
  - Hydrologic and Seismic Design Deficiency and Embankment Drain Repair
  - **3 to 5 years to complete**
- Advised a second opinion on conclusions
  - Senior Review Board
  - December 2004

Senior Review Board

- Review Board
  - Francke Walberg (USACE Retired)
  - Keith Ferguson (National Water Resources Program Director, Kleinfelder)
  - James Talbot (Independent)
- Tasks
  - Assess Condition of Structure
  - Recommendations for continued operations
  - Methods for Temporary and Permanent Repairs

December 2004 - Review Board

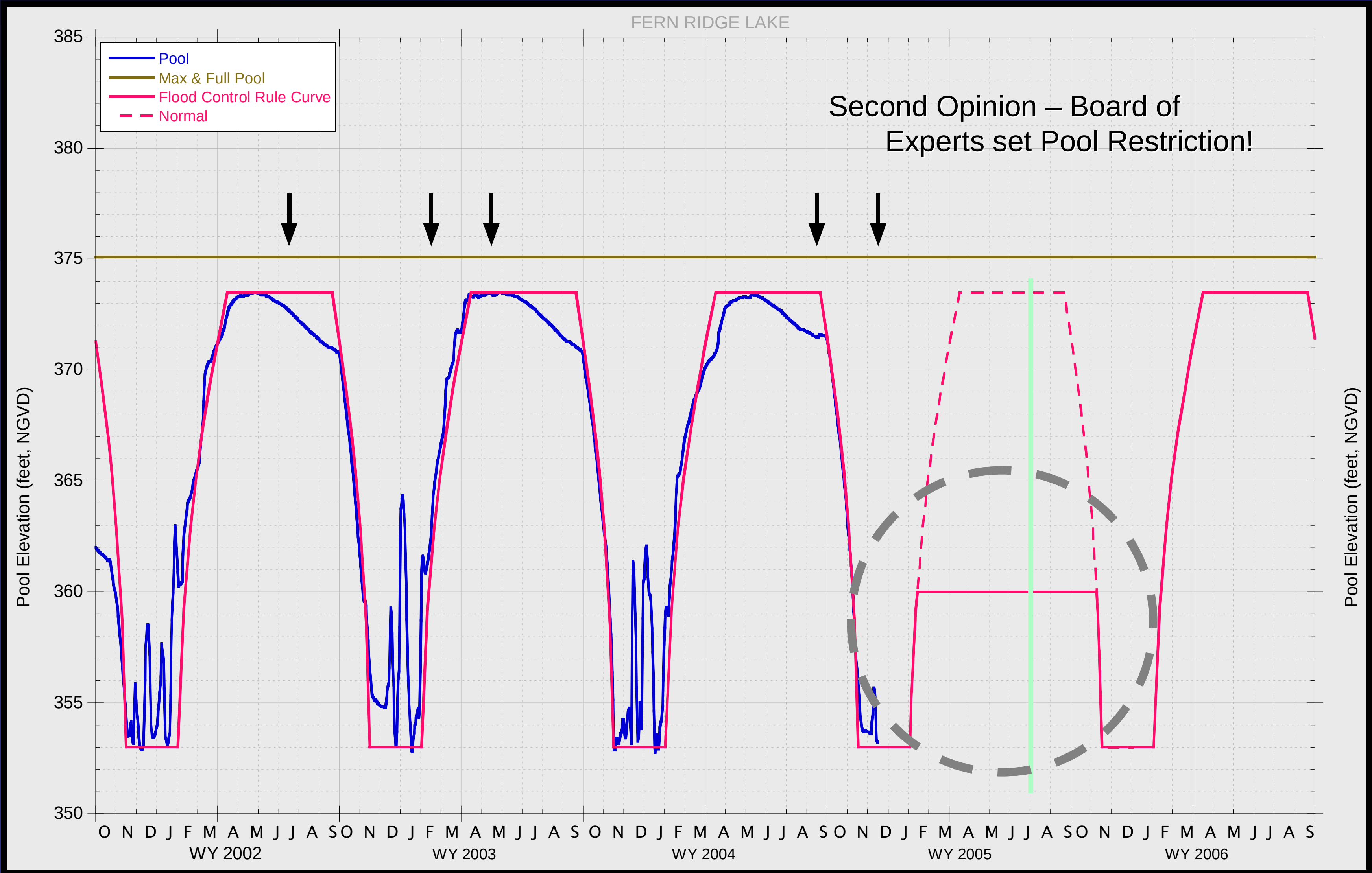
- "Active state of failure by piping and/or internal erosion"
- 20-30% Chance of failure during the next 5 years
- Dam will steadily worsen without a repair even with operational restrictions in place
- And...

Review Board

- Operation restrictions are required
  - Maximum pool height should be reduced by 13.5 feet to elevation 360 feet

- “District’s focus should be immediately shifted from investigations and evaluation to development and implementation of corrective actions.”

December 2004



Operation under Restriction

- Flood control storage reduced by ~9/10
- Conservation storage reduced by over 4/5
  - Irrigation – unknown
  - Flow augmentation – unknown
- Lake depths – most recreational use eliminated
- $$$ Cost? How many seasons?

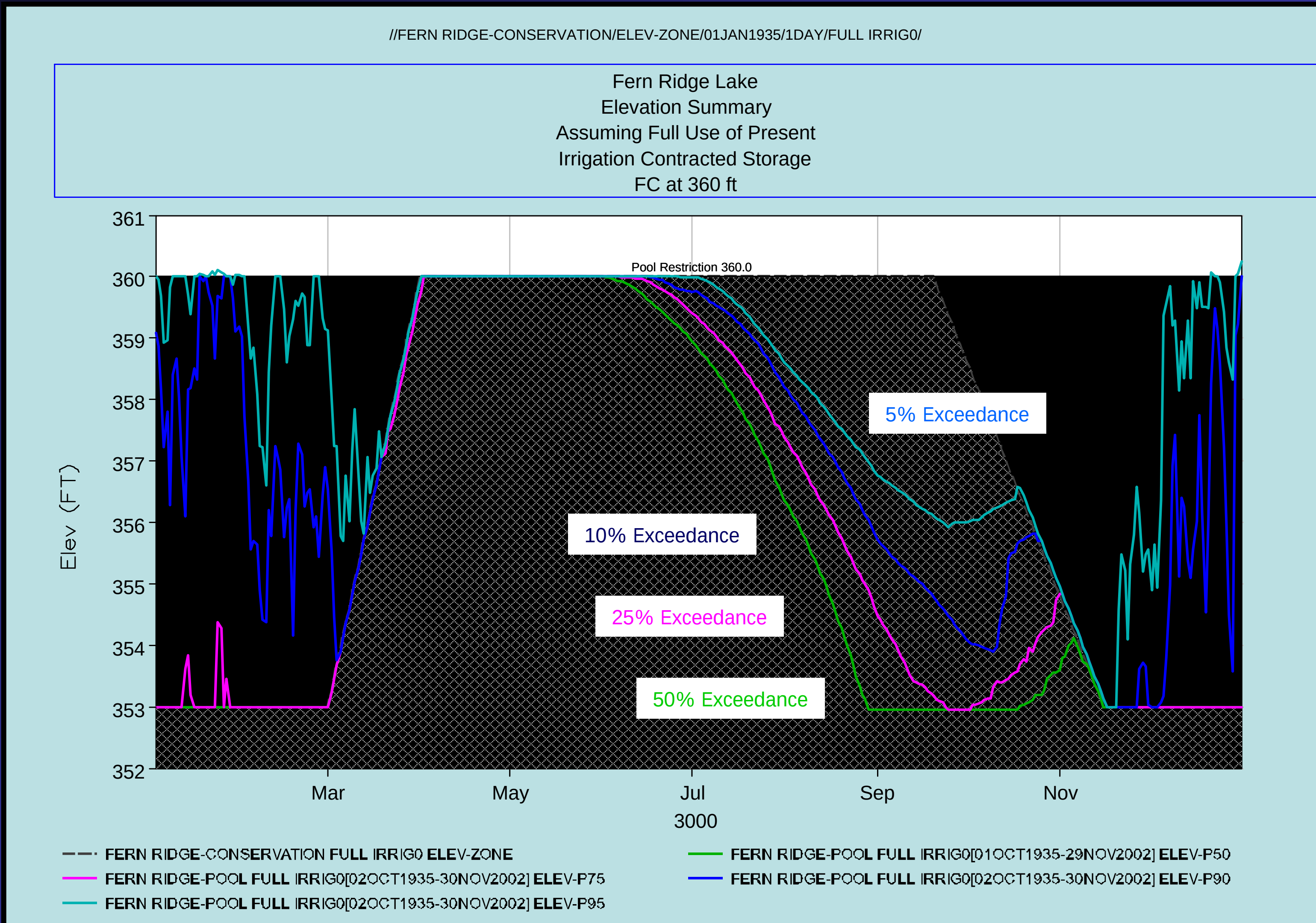
January 2005 - Evaluations

- Jan 2005
- Evaluated Numerous Project Options
  - Impacts to project benefits
- Flood Control
  - New flood control constraints
  - Risk Calculations
- Irrigation
  - Period of Record Irrigation Evaluations
  - Negotiated possible voluntary restraints
- Public Input

Project Benefits

- Flood Control Annual Benefit
  - $400M in damages prevented over life of project
  - $80M in 1996 & Over $40M each in 1997 and 1999
- Irrigation Annual Benefit
  - $1.5M to $2.9M for Agricultural Products
- Recreation Annual Benefit:
  - 600,000 Visitors per year
  - $5M in local benefits and $3.5M in indirect benefits

Irrigation

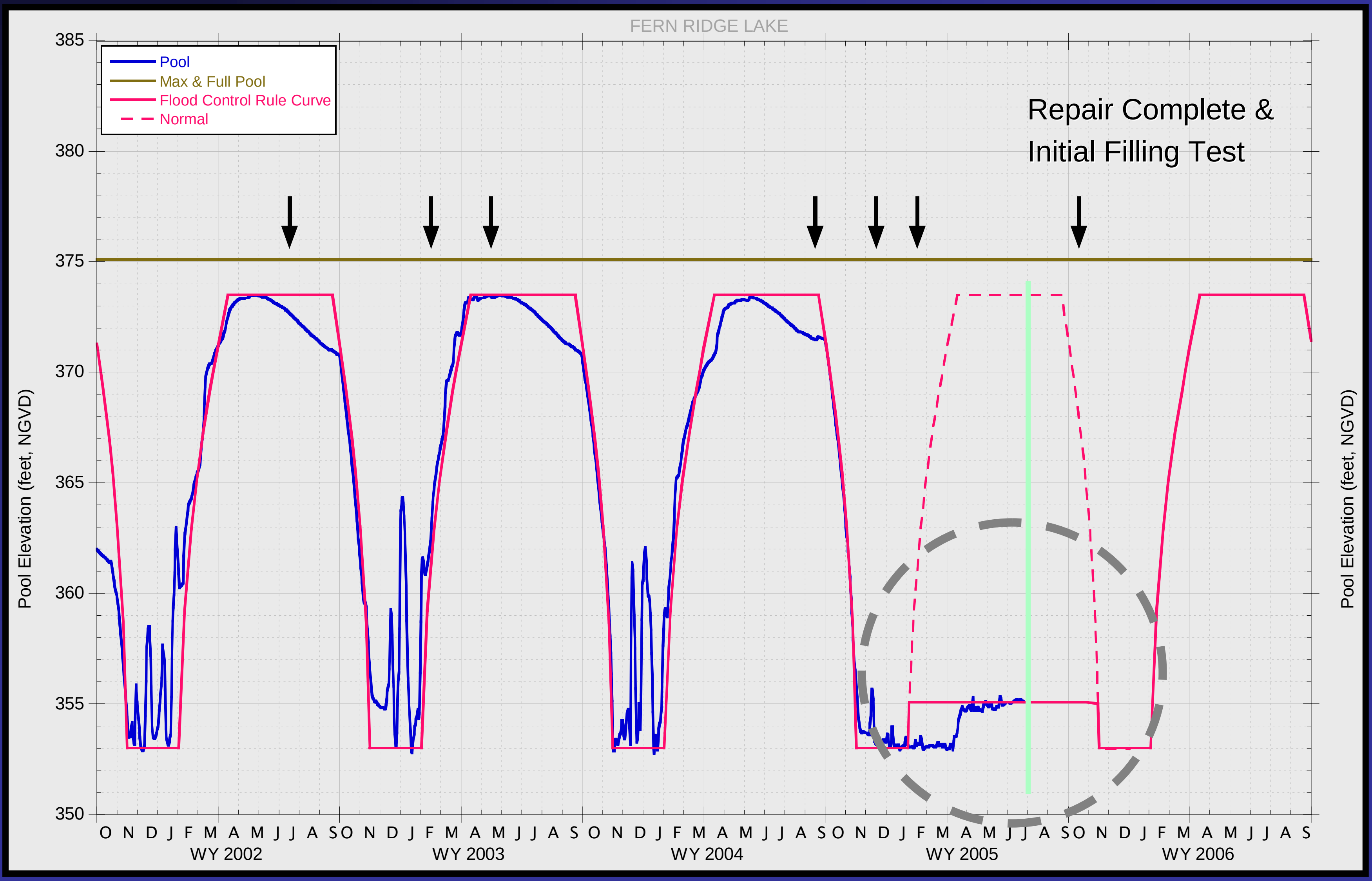


//FERN RIDGE-CONSERVATION/ELEV-ZONE/01JAN1935/1DAY/FULL IRRIG0/
Fern Ridge Lake
Elevation Summary
Assuming Full Use of Present
Irrigation Contracted Storage
FC at 360 ft
Elev (FT)
361
360
359
358
357
356
355
354
353
352
Pool Restriction 360.0
5% Exceedance
10% Exceedance
25% Exceedance
50% Exceedance
Mar
May
Jul
Sep
Nov
3000
FERN RIDGE-CONSERVATION FULL IRRIG0 ELEV-ZONE
FERN RIDGE-POOL FULL IRRIG0[01OCT1935-29NOV2002] ELEV-P50
FERN RIDGE-POOL FULL IRRIG0[02OCT1935-30NOV2002] ELEV-P75
FERN RIDGE-POOL FULL IRRIG0[02OCT1935-30NOV2002] ELEV-P90
FERN RIDGE-POOL FULL IRRIG0[02OCT1935-30NOV2002] ELEV-P95

February 2005 - The Decision

- Vertical Team
  - NWP; NWD; HQ
  - Unanimous decision to proceed with embankment repair
- Design and Award done – May 2005
- Repair complete – October 2005

October 2005

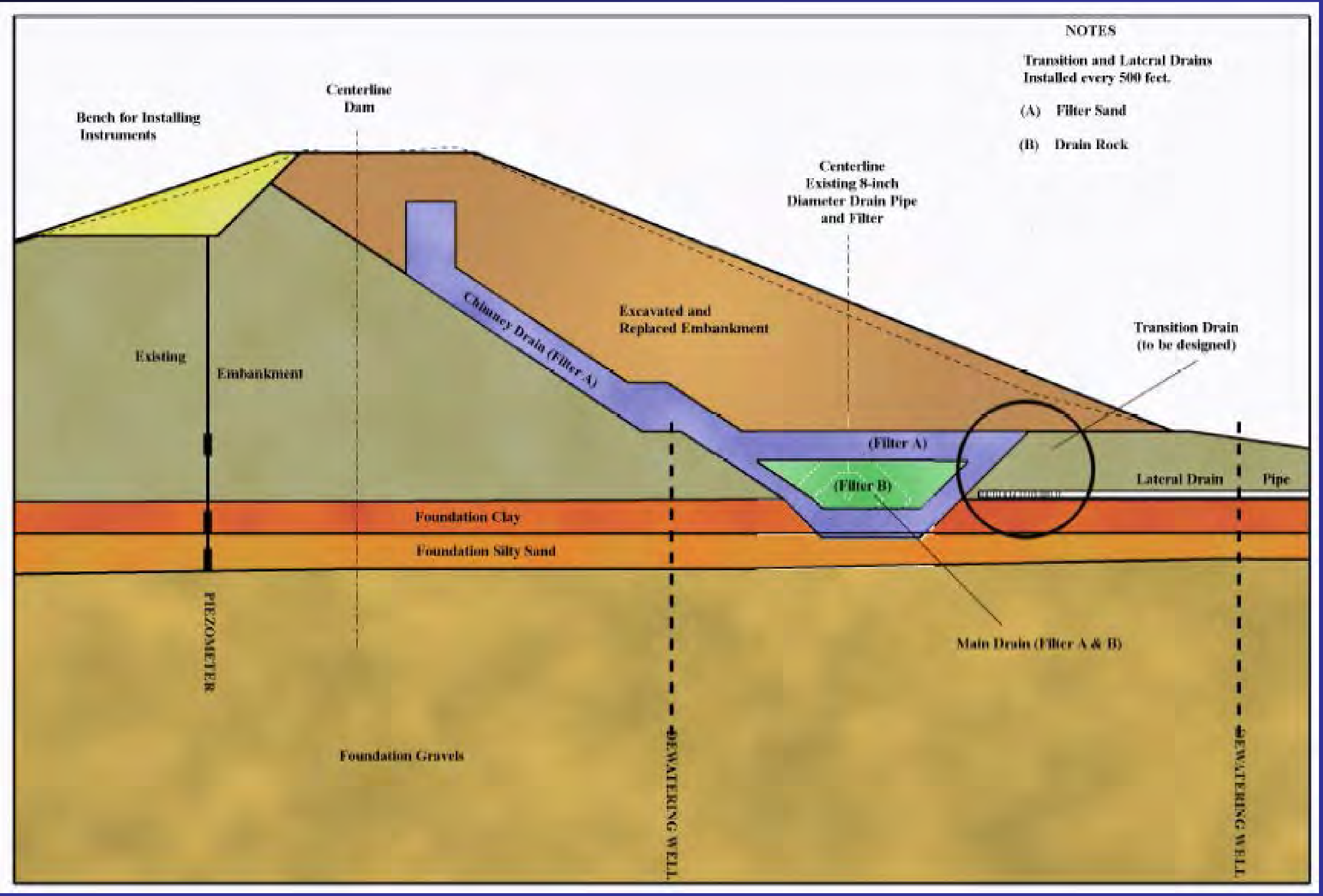


Ongoing Efforts

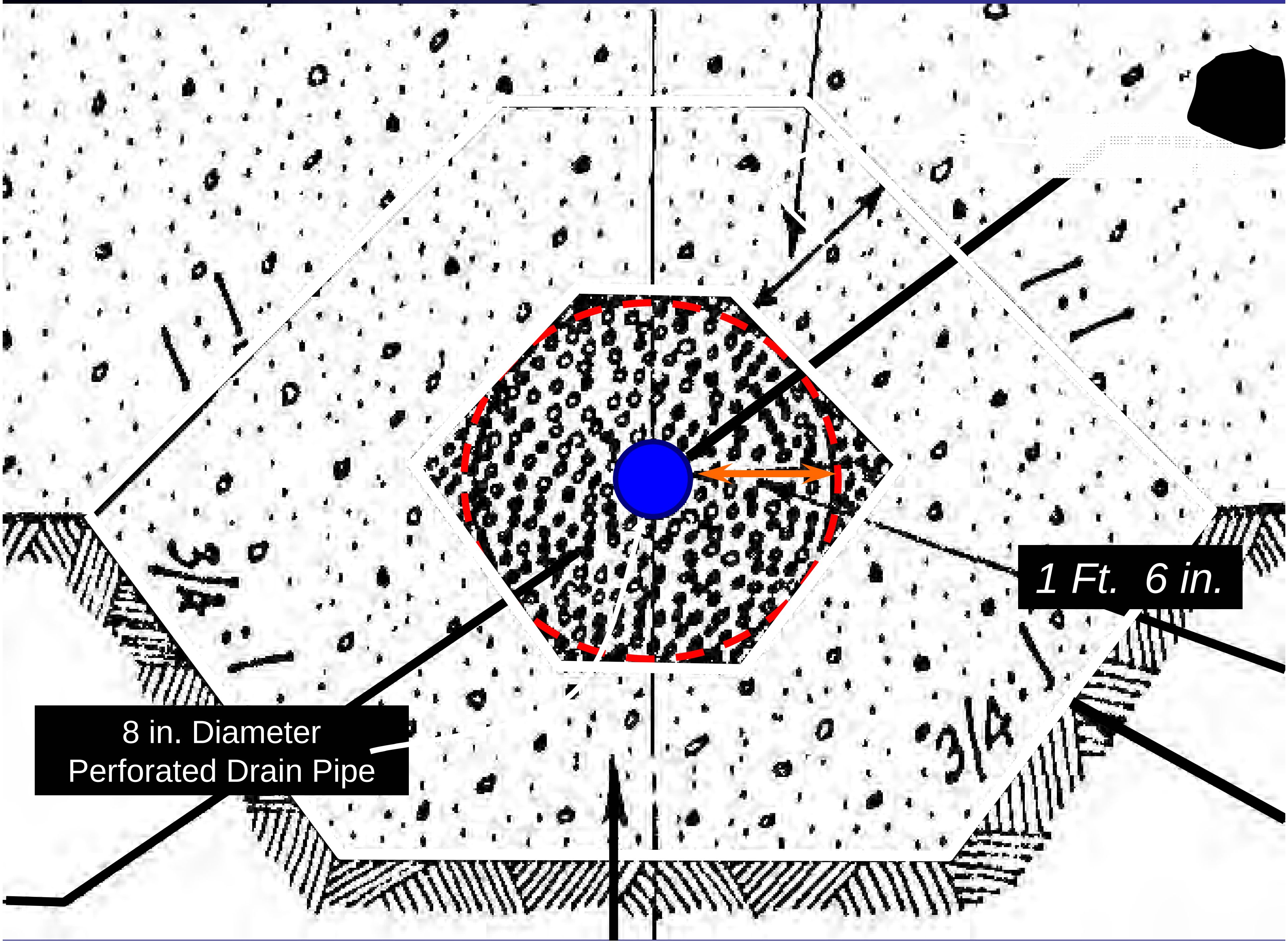
Ongoing Efforts

Ongoing Efforts

Questions?



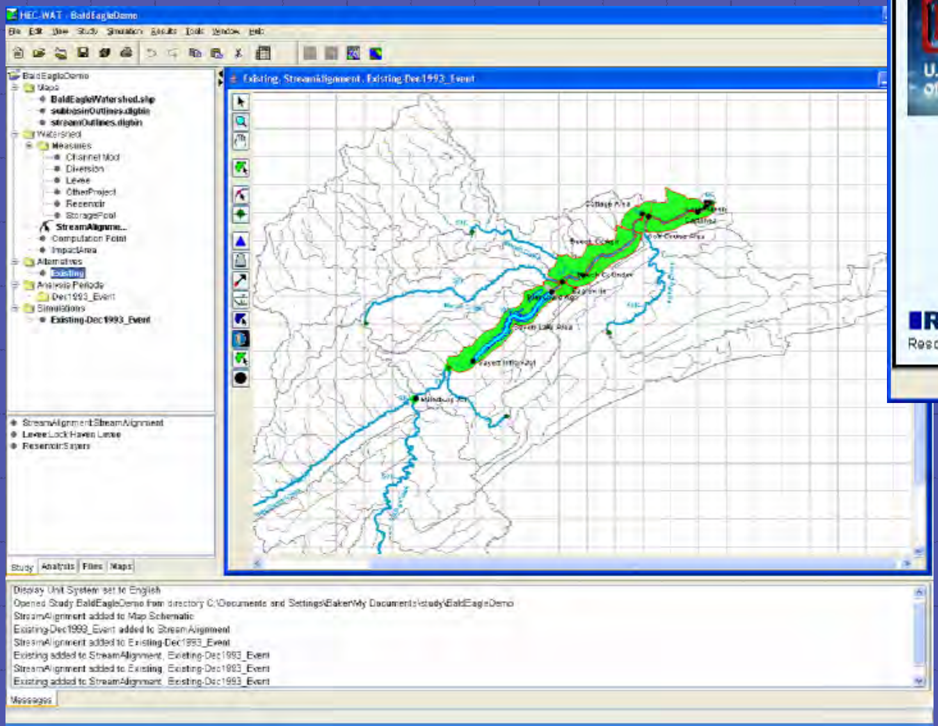
NOTES
Transition and Lateral Drains Installed every 500 feet.
(A) Filter Sand
(B) Drain Rock
Bench for Installing Instruments
Centerline Dam
Centerline Existing 8-inch Diameter Drain Pipe and Filter
Chimney Drain (Filter A)
Excavated and Replaced Embankment
Existing
Embankment
Transition Drain (to be designed)
(Filter A)
(Filter B)
Lateral Drain
Pipe
Foundation Clay
Foundation Silty Sand
PIEZOMETER
Main Drain (Filter A & B)
Foundation Gravels
DEWATERING WELL
DEWATERING WELL



1:1
3/4
1 Ft. 6 in.
8 in. Diameter
Perforated Drain Pipe

Watershed Analysis Tool

HEC-WAT Program



Watershed Analysis Tool (HEC-WAT)

- Corps watershed and water resources management studies identify problems and opportunities and perform analyses to address them.
- Studies require hydrologic, hydraulic, economic, environmental, and social impact assessments.
- Need to develop an interface that will streamline and integrate the analytical process using the tools commonly applied by the multi-disciplinary teams of the District offices.
- The goal is to help Districts perform watershed and/or system-wide studies.

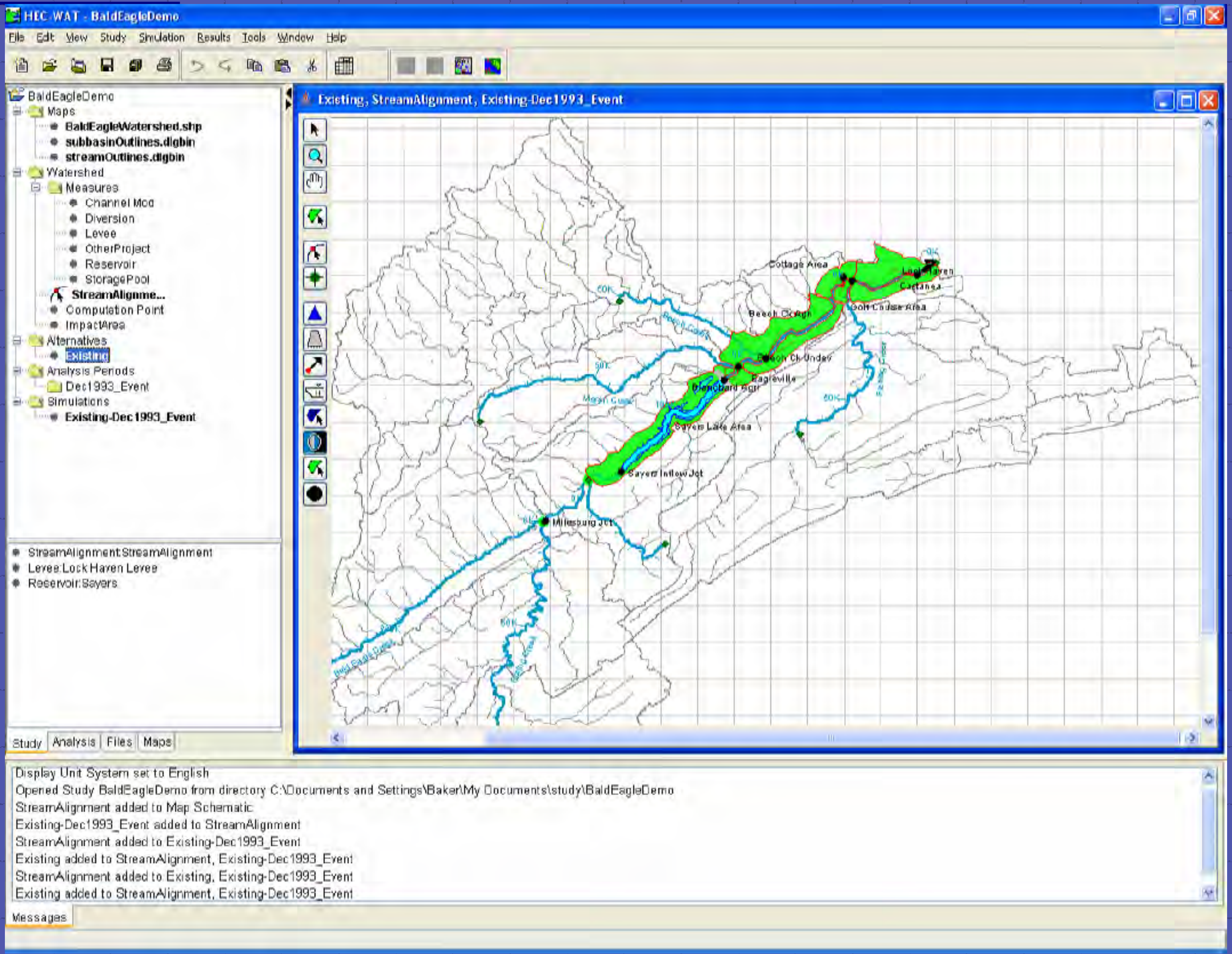
Watershed Analysis Tool (HEC-WAT)

- By developing the capabilities needed to integrate the tools used by the Districts during the analytical process (*HEC-HMS, HEC-ResSim, HEC-RAS, HEC-FIA, HEC-FDA, HEC-EFM, and other software*)
- The WAT will improve coordination and communication across Project Delivery Teams (PDT).
- Share data across models
- Involve modelers early in the study process
- Encourage a team approach

Design

- Will leverage past research and implementation:
  - Design
  - Software Coding
  - Historic Data
  - Watershed Models
  - Spatially reference maps and displays
  - Internet/Web-sight links

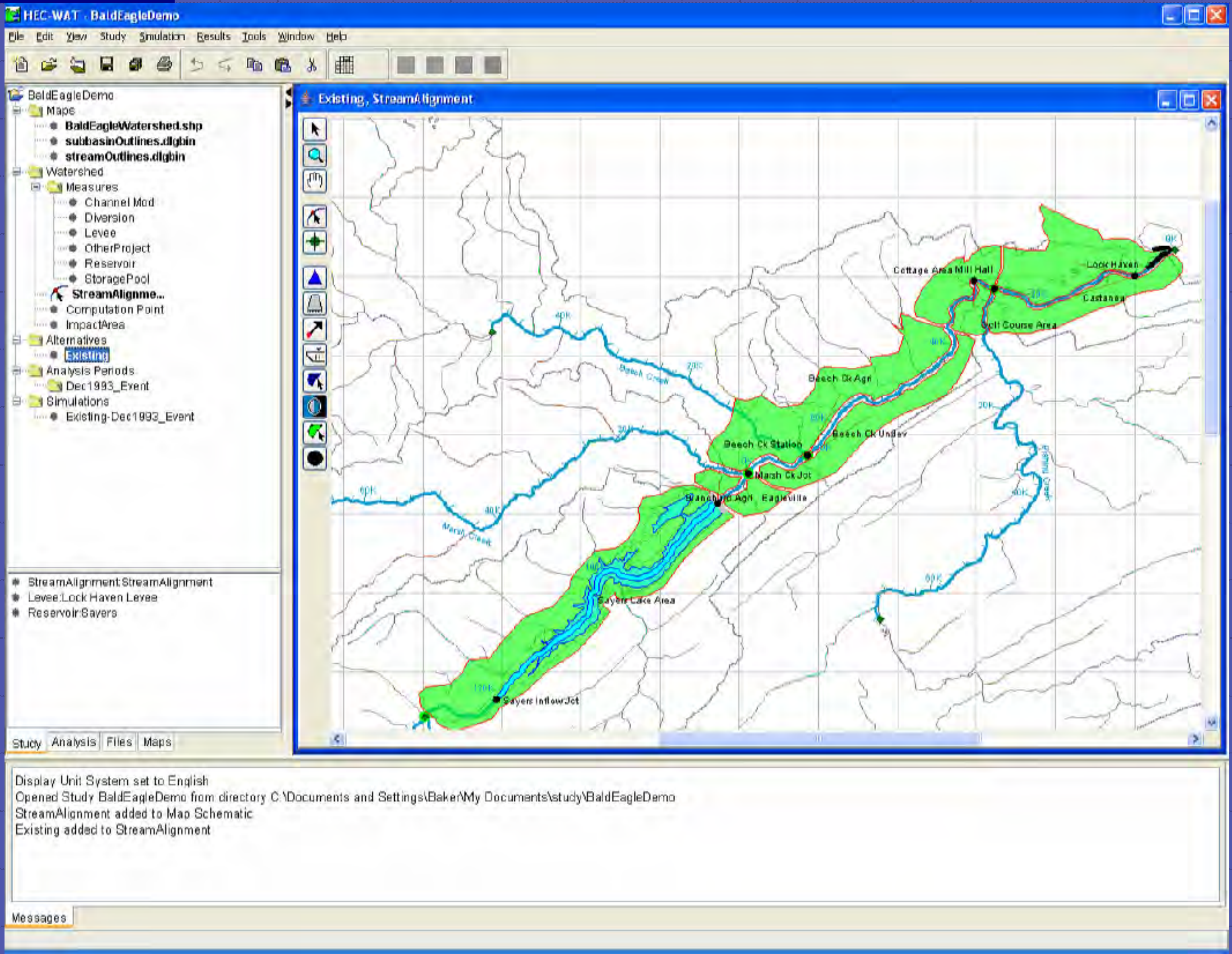
WAT Main Window



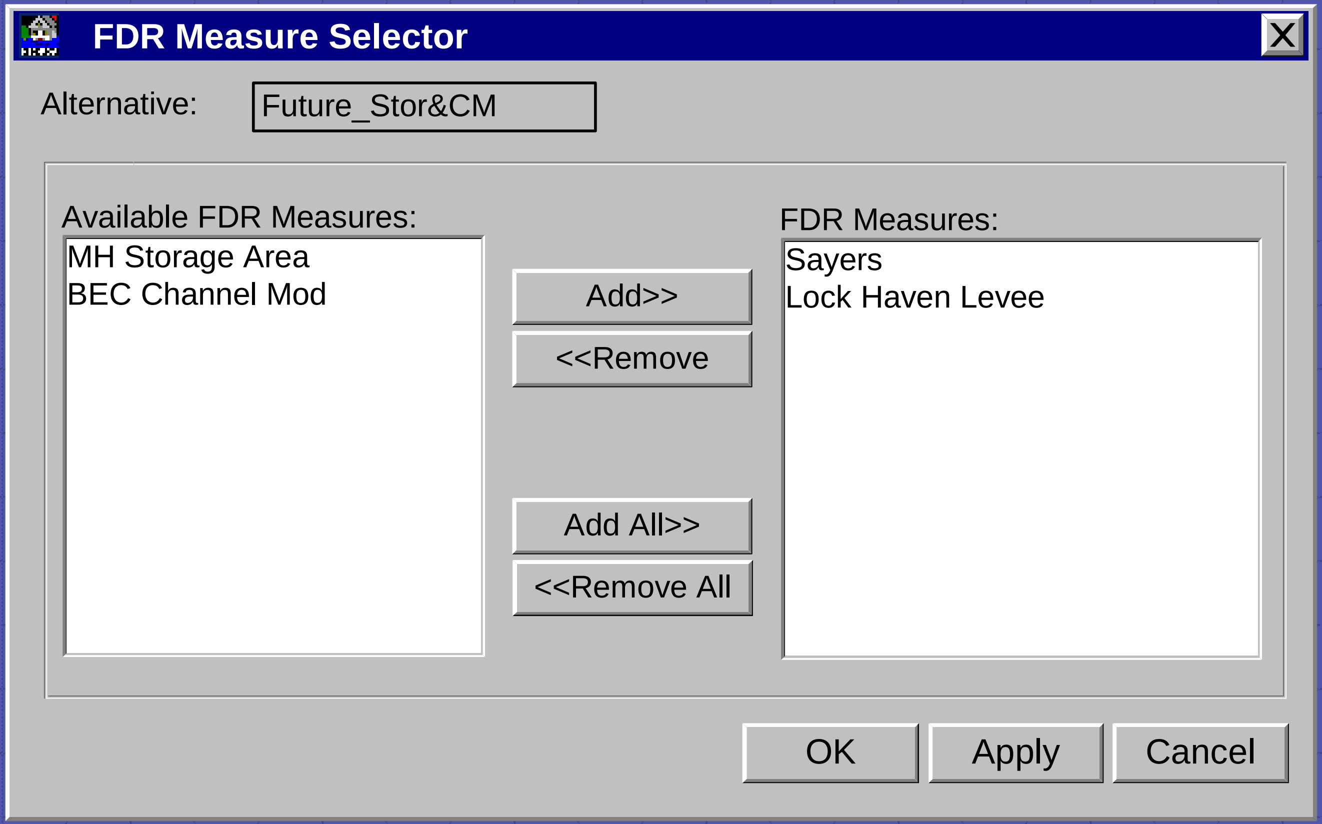
WAT Alternative Table

	Time Window 1					TW2	TW3	TW4	Time Window 5							
	Period of Record					Calibaration (History)			Events							
		Historic	Global	Precp 3	Precp 4	1997	1986		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
Alternative 1	HMS	X	X			Jan97X1	Jan86X2		Ex_2yr	Ex_5yr	Ex_10yr	Ex_25yr	Ex_50yr	Ex_100yr	Ex_200yr	Ex_500yr
Base	ResSim					Jan97Res	Jan86Res		1980 Rule Curve							
Existing	RAS					Jan1997.p03	Jan1986.p02		RAS1996.p03							
	FDA	FIA1	FIA 2			FIA97	FIA86		**FDA Existing**							
Alternative 2	HMS															
2040	ResSim															
Existing	RAS															
	FDA								**FDA Most Likely Future Year X Eqiv Annual Damage**							
Alternative 3	HMS															
Base	ResSim	OPT 1		OPT 2												
Existing w /	RAS															
Enlarged SW	FDA								**FDA Prob**							
Alternative 4	HMS															
2040	ResSim															
Existing w /	RAS															
Enlarged SW	FDA								**FDA Prob**							

Existing Alternative

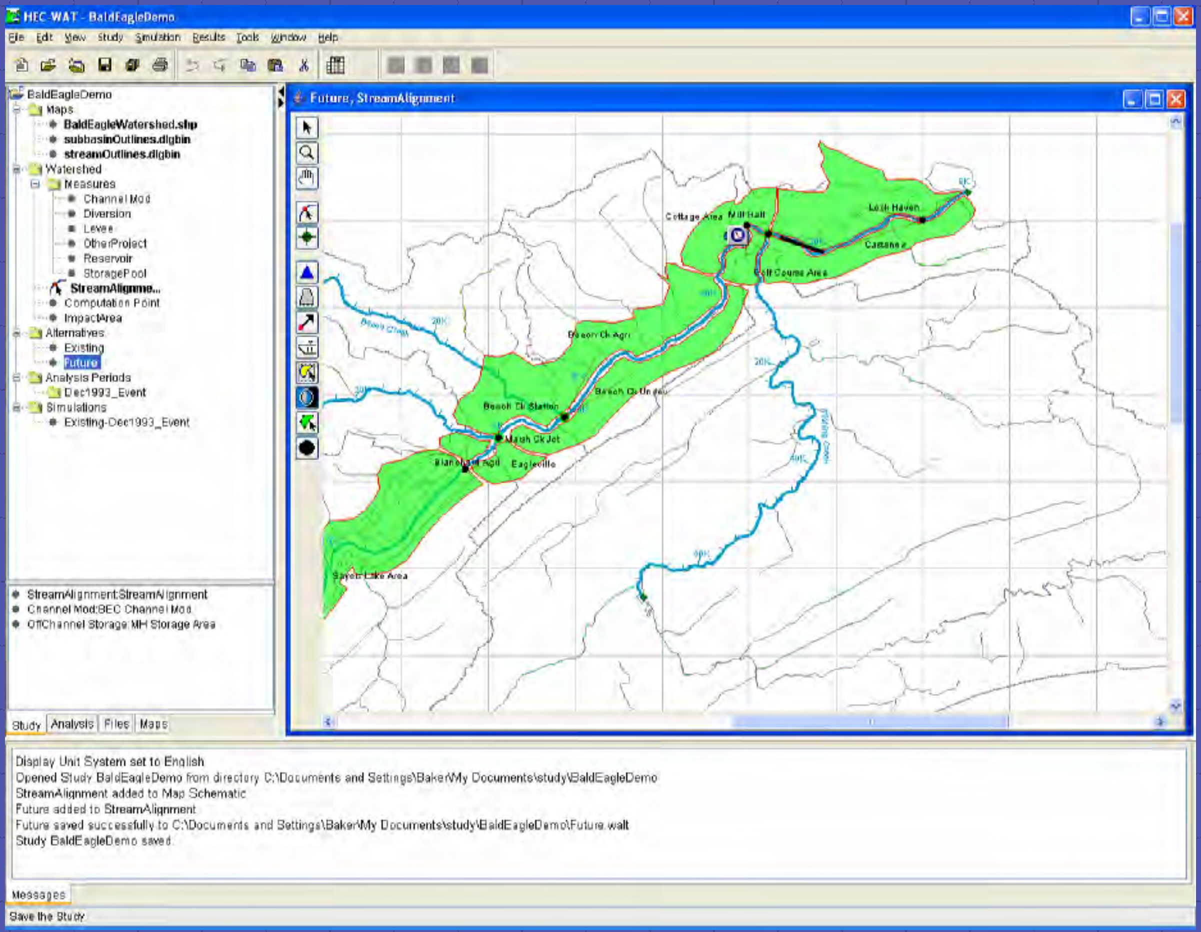


FDR Measure Selector



Future Alternative

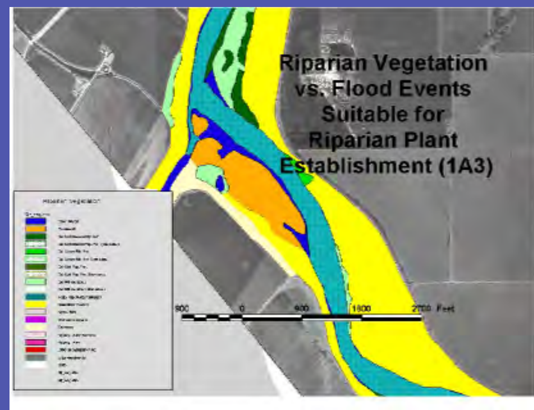
With Storage and Channel Modification

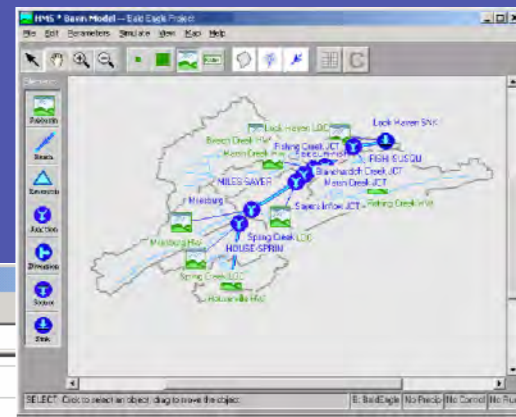


Data and Statistics

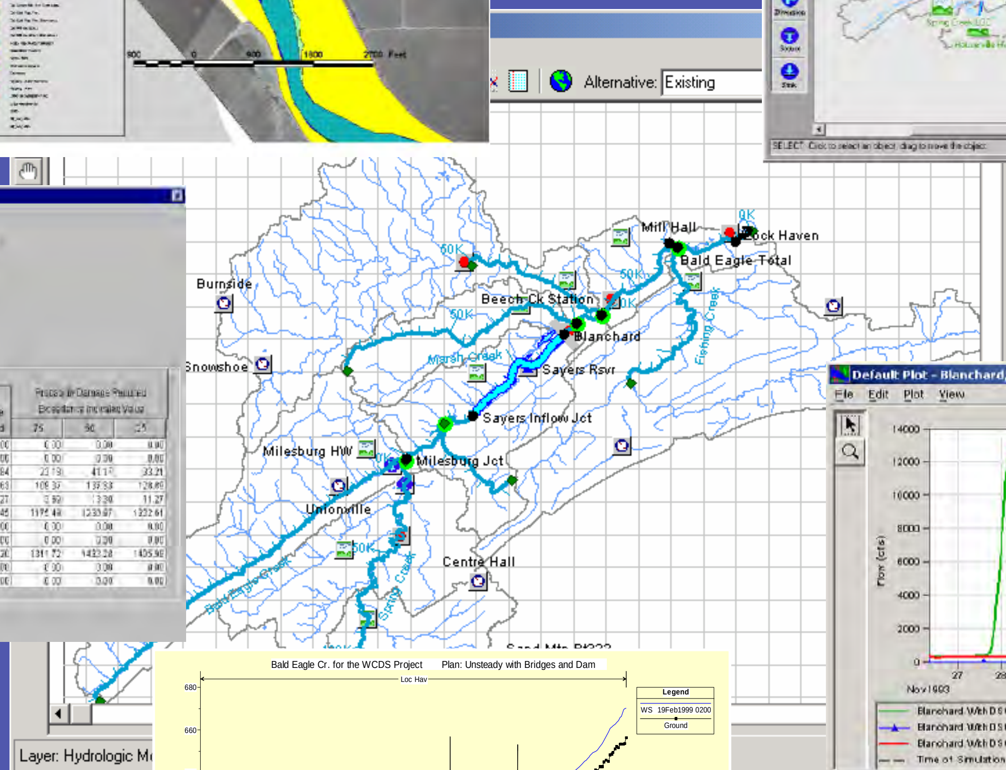
- Data Acquisition
  - Spatial Depiction
  - DSS
  - Corps Water Management System (CWMS) Database
- Data Visualization (HEC-DSSVue)
  - Anomalies
  - Breaks in record
  - Time Window
- Statistical Analysis
  - Frequency Analysis
  - Durational Analysis
  - Regression Analysis

Environmental

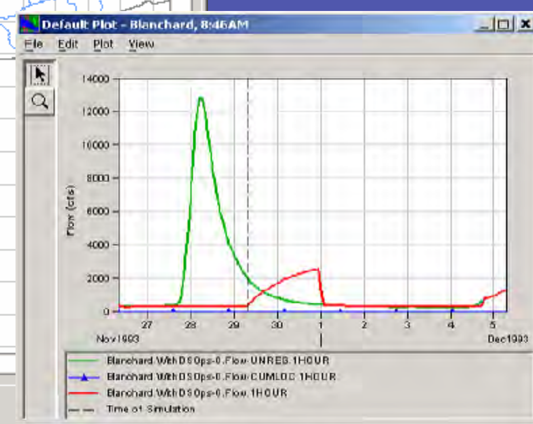




Hydrology

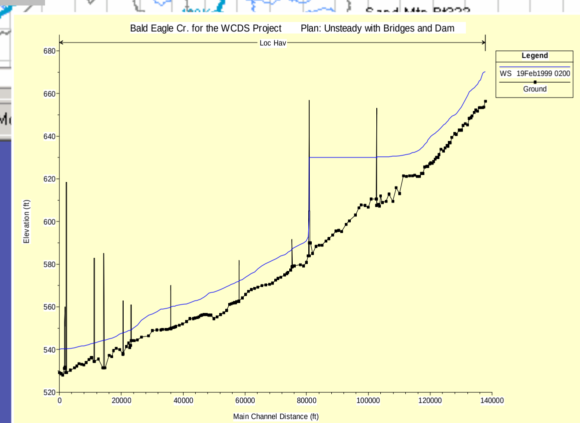


Flood Damage



Reservoir

Hydraulics



List of Alternatives

List of Alternatives

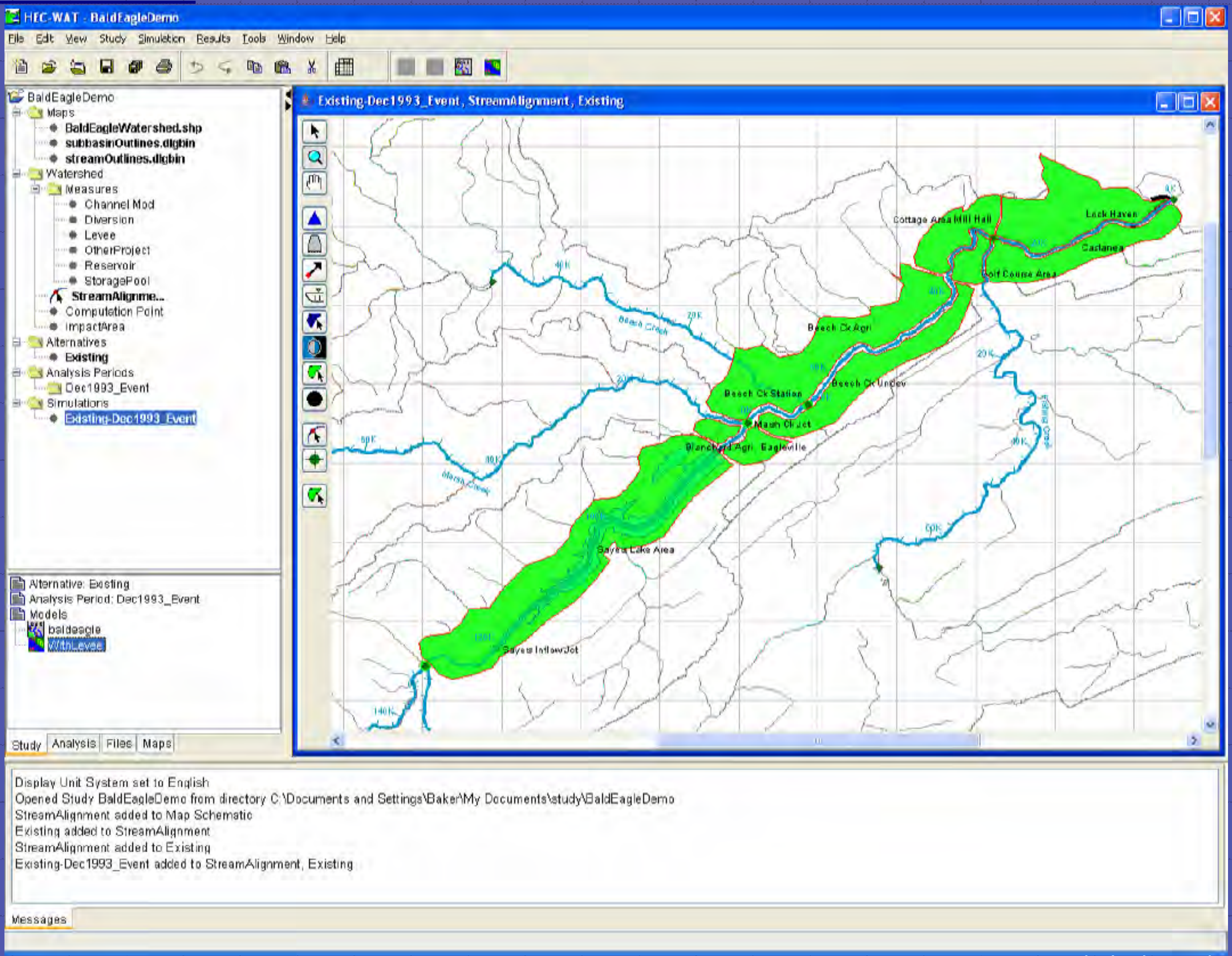
File Help

Watershed Name
List of Alternatives

Name	Description
WithLevee&Stor	Alternative with storage and levee
Stor&CM	Alternative with off-site storage and channel modfica....
WithEchoValleyLevee	Alternative with Echo Valley Levee.
WithPowersRes	Alternative with Powers Dam.
Existing	

Close

Watershed Analysis Output



Simulations - Output Reports and Graphs

- Flow frequency curves
- Statistical plots
- Flow/stage hydrographs
- Inflow, storage, stage, outflow from reservoirs
- Cross-section plots
- Flood inundation boundary maps/water surface profiles
- Plan comparisons
- Expected Annual Damage (EAD) with risk
- Cost (National Economic Development (NED) plan)
- Environmental displays (National Ecosystem Restoration (NER))

Future Goals

- Alpha Version (end of FY05)
- Peer Review
- Implement FDA and EFM
- Beta Version (end of FY06)
- First official release, (end of FY07)
- Documentation
- Training

Chris Dunn, P.E.

U.S. Army Corps of Engineers

Hydrologic Engineering Center

Chief, Water Resource Systems Division

530 756-1104

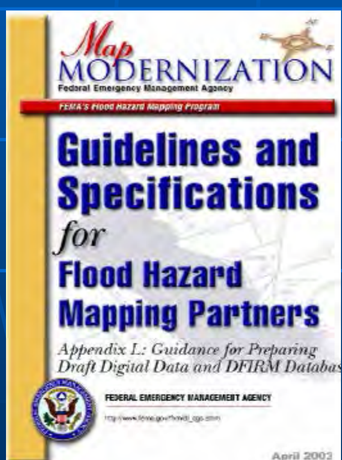
christopher.n.dunn@usace.army.mil

GIS & Surveying to Support FEMA Map Modernization

Mark Flick

GD&S Program Manager

Nashville District



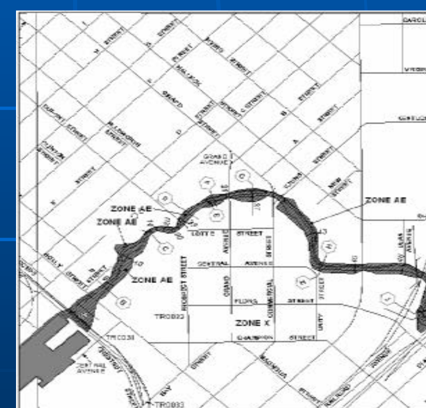
Map MODERNIZATION
Federal Emergency Management Agency
FEMA's Flood Hazard Mapping Program

Guidelines and Specifications for Flood Hazard Mapping Partners

Appendix L: Guidance for Preparing Draft Digital Data and DFIRM Databas

FEDERAL EMERGENCY MANAGEMENT AGENCY

April 2003



GIS & Surveying to Support FEMA Map Modernization

OUTLINE

1) National PDT for FEMA Support

2) Introduction to Washington D.C. Map Modernization Study

3) Bridge Survey Techniques Applied

4) GIS Tools available for Map Modernization Studies

GIS & Surveying to Support FEMA Map Modernization

National PDT for FEMA Support

- Formed as a result of FEMA Region III "rocking the boat"
- HQUSACE recognition and support – Spirit of USACE 2012
- Project Management located at RS/GIS Center of Expertise
- Organization-wide PDT membership – Districts, Labs

GIS & Surveying to Support FEMA Map Modernization

National PDT for FEMA Support

Why is FEMA interested in working with a USACE National PDT?

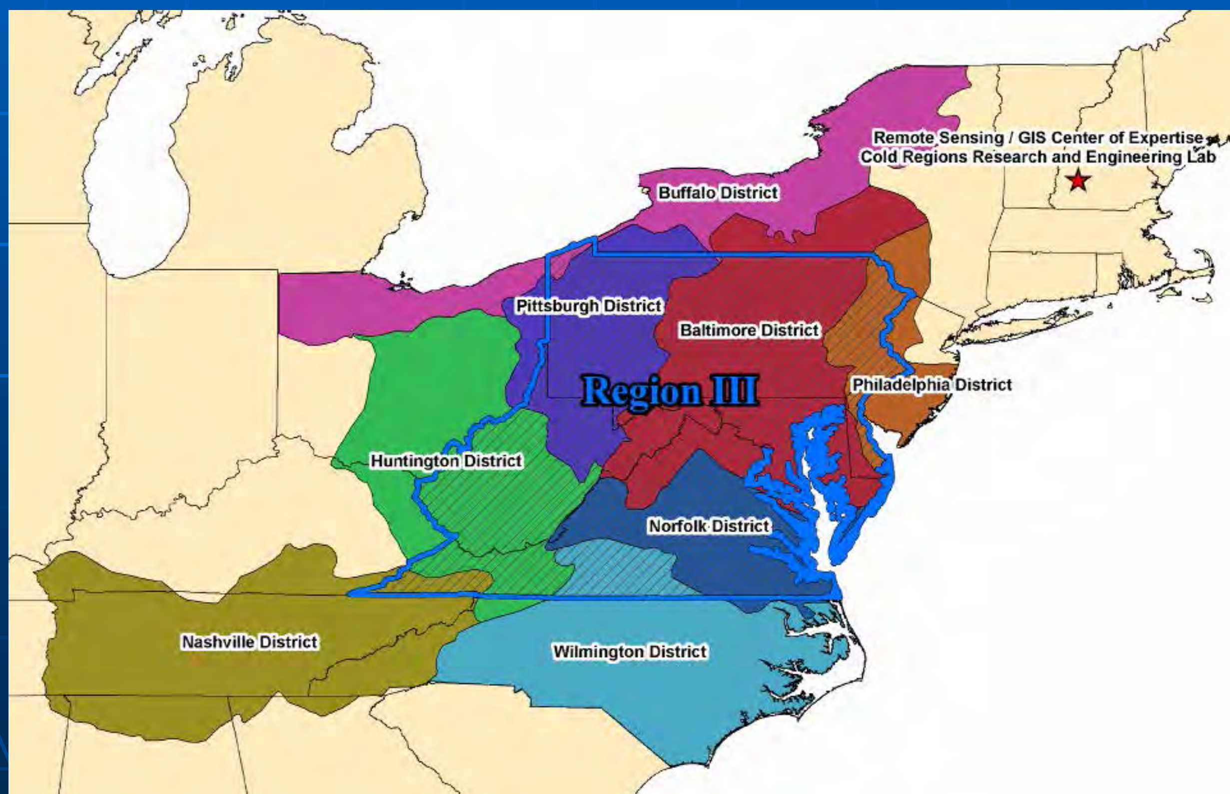
Inspiration came from Corps' presentations on USACE 2012 … Brings to the table scalable staffing and scalable management that cut across the Corps' areas of expertise … Allows us to use the Corps for more work than would be possible by just assigning to Districts based on their boundaries … Gives us confidence that the Corps is maintaining levels of expertise in the disciplines we need.

Excerpts from conversation with Jon Janowicz, FEMA Region III

GIS & Surveying to Support FEMA Map Modernization

National PDT for FEMA Support

Why is USACE interested in forming a National PDT?



National PDT for FEMA Support

INVITATION:

What: **FEMA Meeting**

When: **Thursday evening, 5:30PM – 7:30PM**

Where: **Conference Room G (first floor)**

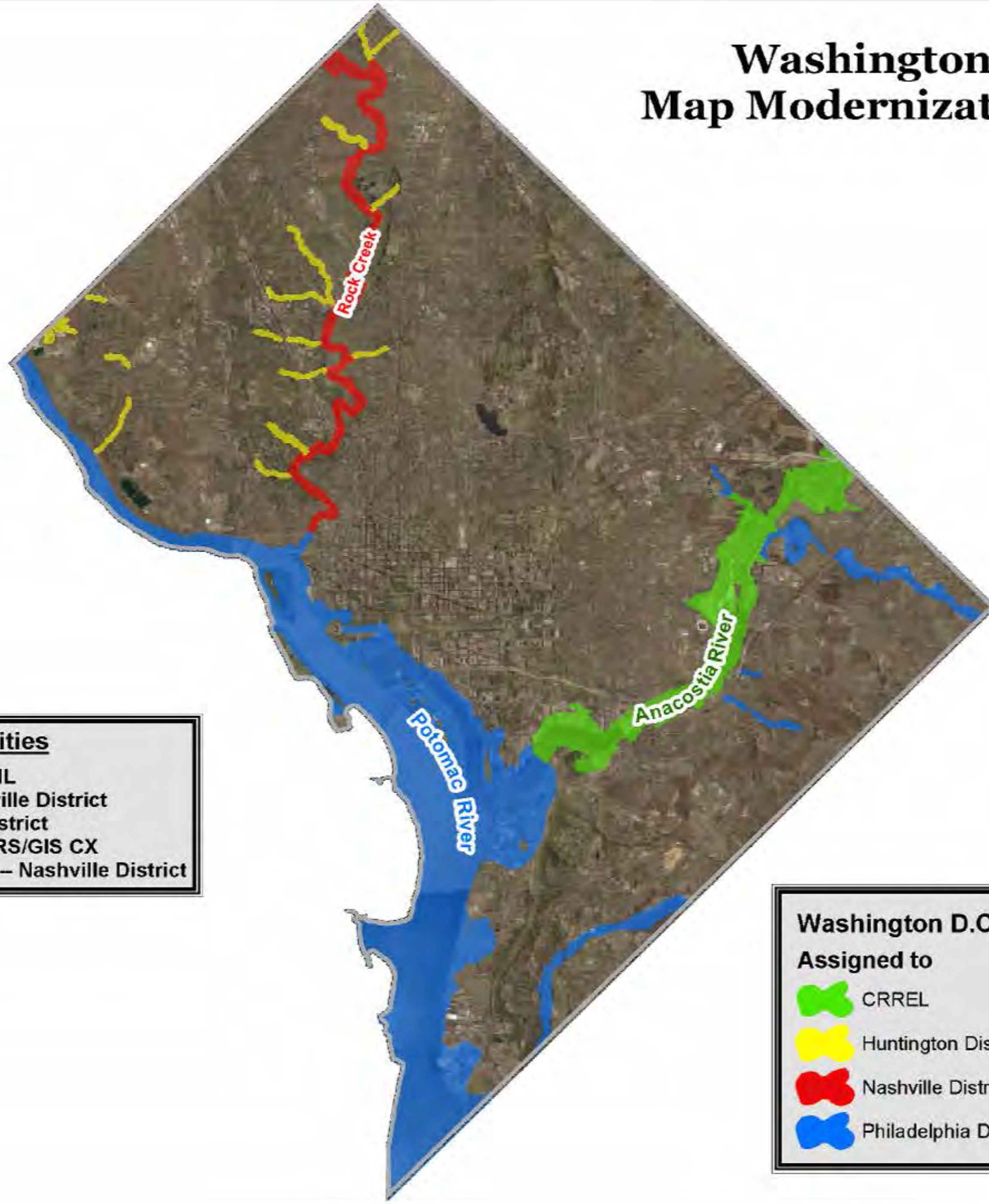
Who: **Anyone interested in Map Modernization work and/or the National PDT**

GIS & Surveying to Support FEMA Map Modernization

Washington DC Map Mod Study

- First Map Mod Study for National PDT
- PDT Membership from CHL, CRREL, LRH, LRN, NAB, NAP
- $200,000 study to be completed in 1-year
- 42 stream miles of detailed study; 8.75 miles of approximate study

Washington D.C.
Map Modernization Study



Project Responsibilities

Coastal Hydrology -- CHL
Hydraulic Lead -- Nashville District
GIS Lead -- Nashville District
Project Management -- RS/GIS CX
Technical Management -- Nashville District

Washington D.C. Floodplains
Assigned to

- CRREL
- Huntington District
- Nashville District
- Philadelphia District

GIS & Surveying to Support FEMA Map Modernization

Washington DC Map Mod Study

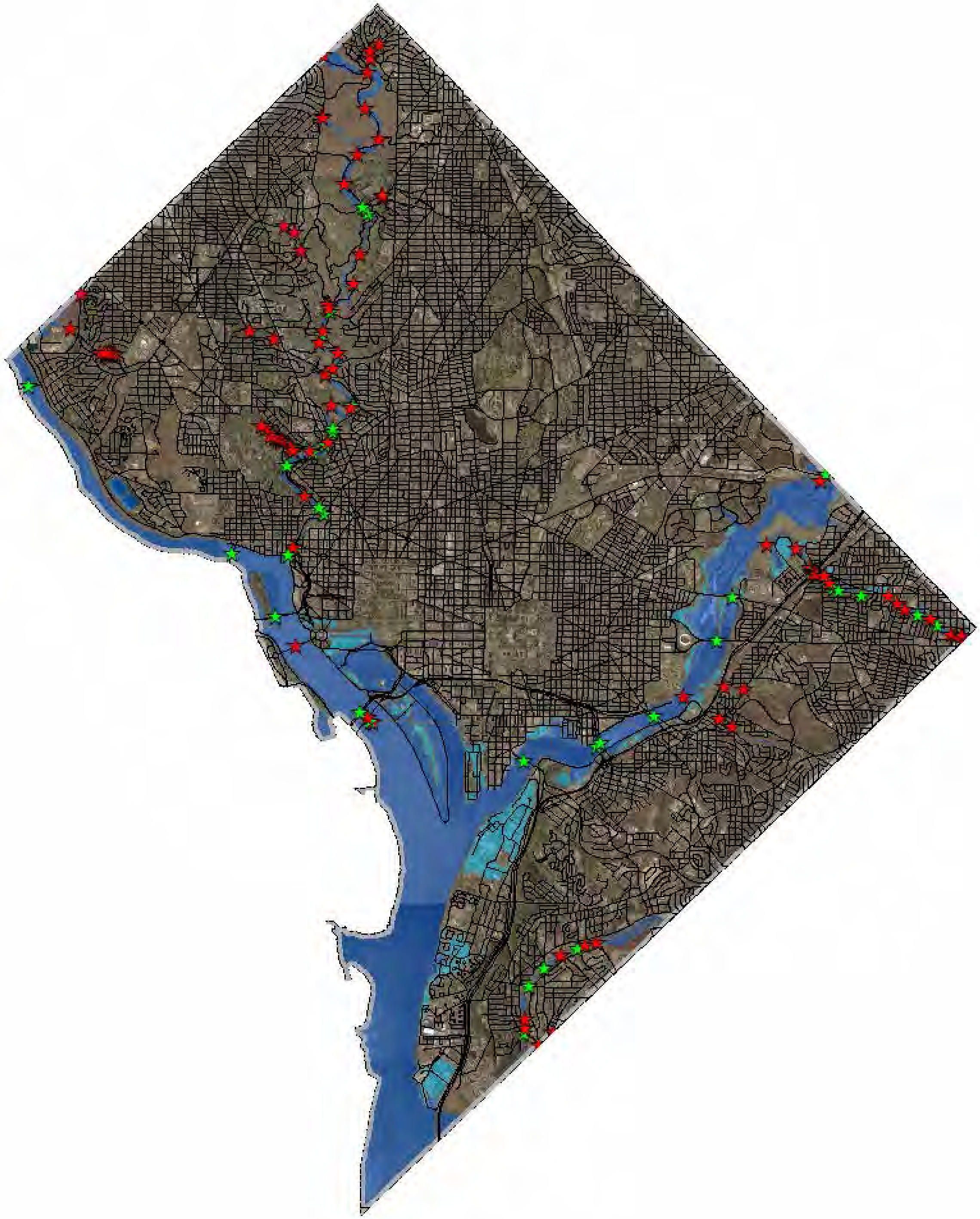
Scope of Work:

- Convert all effective HEC-2 models to HEC-RAS
- Update all bridge sections to current
- Develop new GIS-related method for Approximate Areas
- Use new LIDAR for over-bank portions of cross-sections
- Use new LIDAR for development of innundation areas
- Develop DFIRM geodatabase

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

- 129 current stream crossings (bridges) in effective FIS floodplains
- Limited Budget – Impossible to conduct/contract full survey
- How about "in-the-can" data … Coordination with D.C. DOT
- D.C. DOT had current drawings for 40 of the 129 bridges – Majority of missing data within Rock Creek National Park



GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

- 89 bridges … LIMITED funds … What to do ???
- "Just import from HEC-2" … No way to know if current; Several bridges built after effective HEC-2 models
- "Perform limited surveying and combine with high-resolution GIS data" … Still a costly alternative
- Combine the two – While in the field compare HEC-2 bridges imported into HEC-RAS with actual bridge to judge vintage, and perform limited survey when necessary

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

Survey conducted 28 Feb – 4 Mar 2005 (Cold and snowing !!)

Survey Crew of three (3):

- **Mark Flick - GIS Specialist w/ H&H background and limited surveying**
- **Gordon Gooch – Civil Engineering Technician w/ Surveying background**
- **Jim Barton – Department of Public Works … One hell of a work ethic**

Survey Equipment:

- **Laptop with ArcGIS and all GIS data**
- **Laser dimensioning tool**
- **100-ft tape**
- **Level, tripod and surveying rod**
- **Digital camera**

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

Procedure:

GIS used to: 1) Layout "plan of attack", 2) Navigate D.C.

At each bridge:

- **Navigate to bridge in HEC-RAS model and compare**
- **If model 'matches' present-day, take digital pictures and document w/in the shapefile**
- **If model and present-day do not match, perform limited survey**

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

Limited Survey:

Sketch upstream opening and use laser dimensioning tool to measure all features pertinent to HEC-RAS bridge coding

Survey enough elevations that could be combined with dimensions and GIS data to model the bridge in HEC-RAS

Vertical control in order of preference:

1. **NGS Benchmarks**
2. **LIDAR control points**
3. **Spot elevations**

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

GIS & Surveying to Support FEMA Map Modernization

Bridge Survey Techniques

Reporting:

Field sketches 'prettied up' and scanned

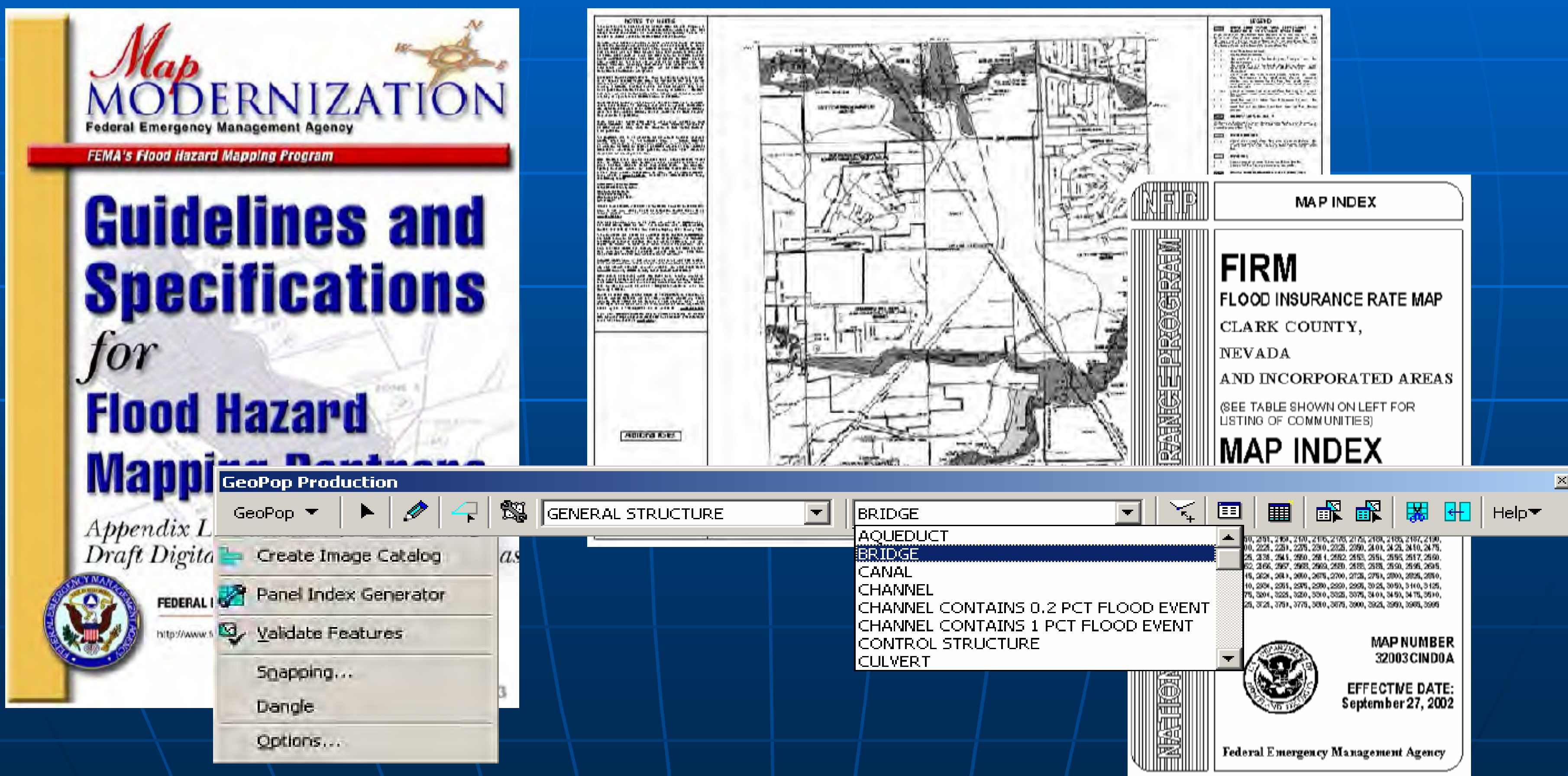
Word document prepared to highlight all relevant information

Word document, digital pictures, and sketch combined into PDF

Example …

GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies



GIS & Surveying to Support FEMA Map Modernization

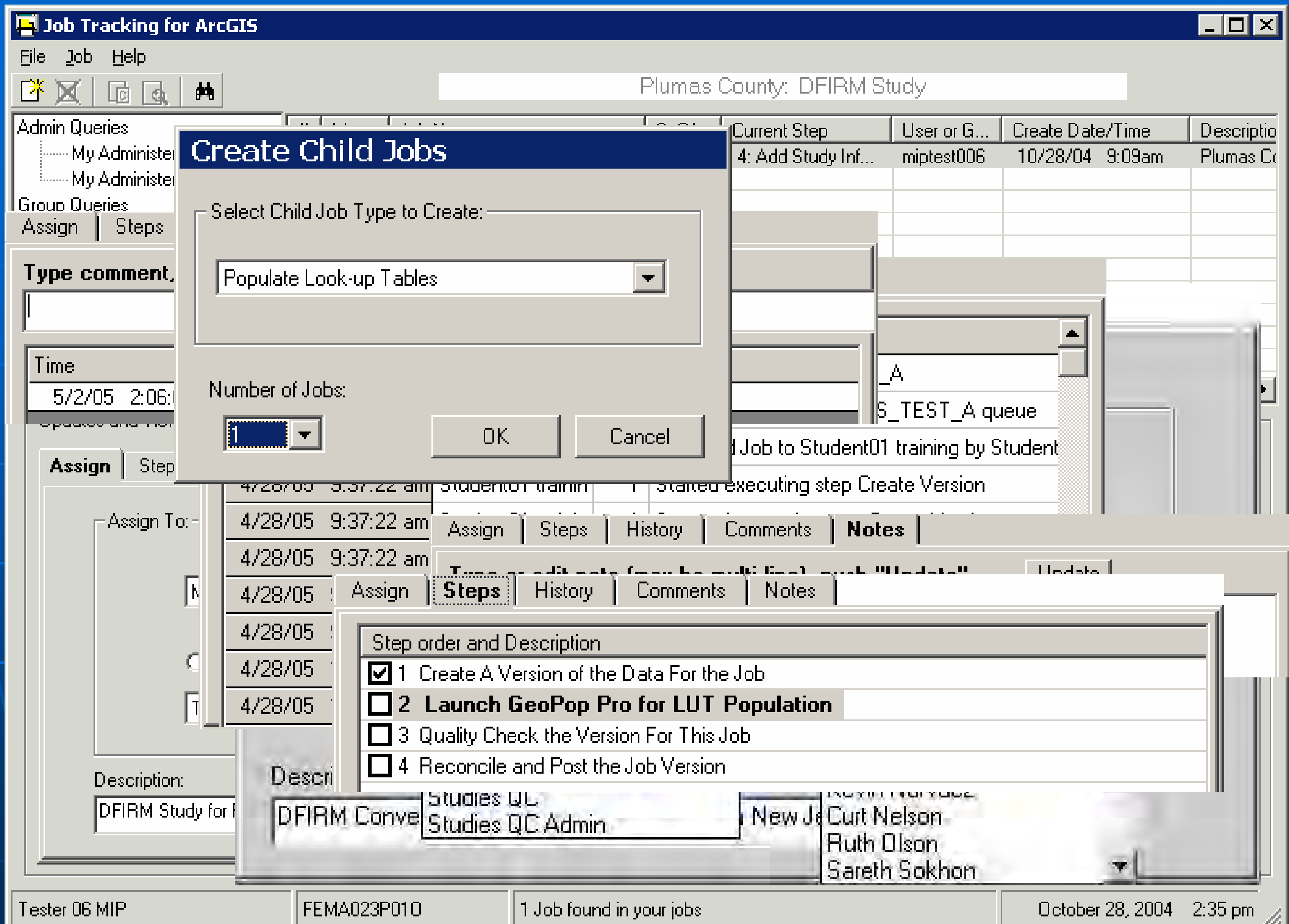
GIS Tools for Map Mod Studies

- FEMA IDIQ Contractor has developed suite of tools to assist in the project management and development of DFIRM geodatabases

- FEMA specifications for DFIRM geodatabases and all the required feature classes are quite voluminous

- Project Management is run on a custom ESRI Job Tracking Extension (JTX) application

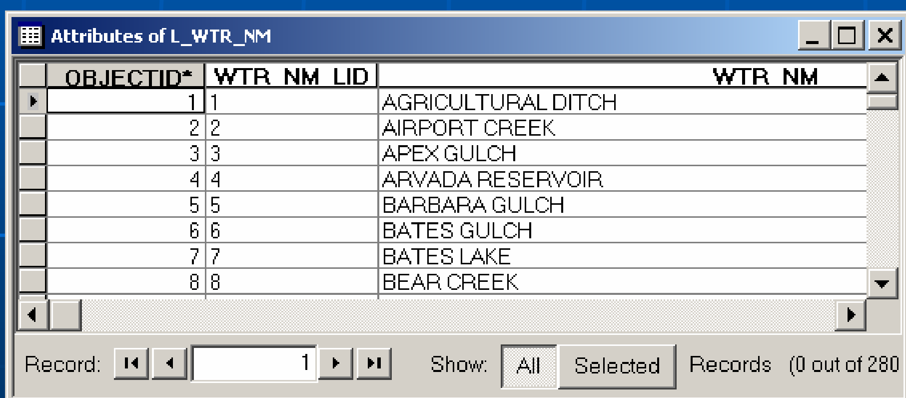
- The JTX and DFIRM Tools are accessible through FEMA's CITRIX server environment … Only after attending training

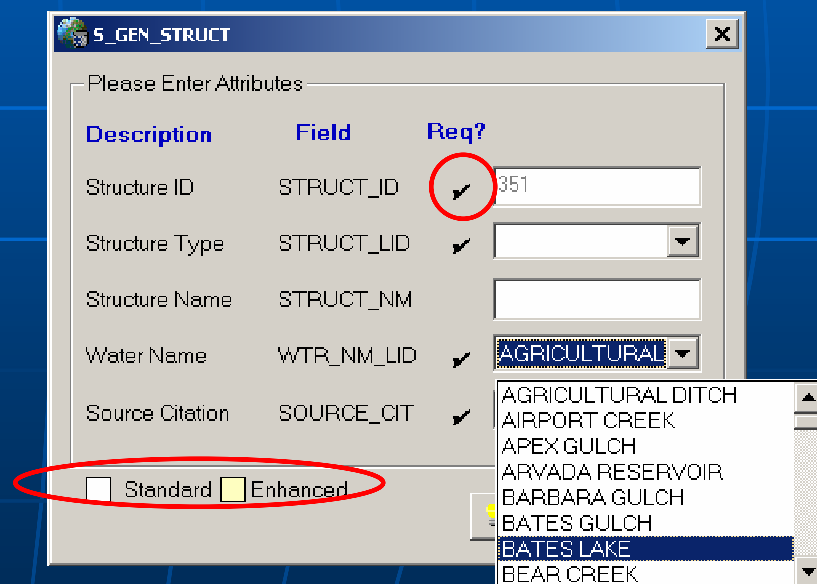

Job Tracking for ArcGIS
File Job Help
Plumas County: DFIRM Study
Admin Queries
Group Queries
Current Step
User or G...
Create Date/Time
4: Add Study Inf...
miptest006
10/28/04 9:09am
Create Child Jobs
Select Child Job Type to Create:
Populate Look-up Tables
Number of Jobs:
1
OK
Cancel
Type comment,
Time
5/2/05 2:06
Assign
Steps
History
Comments
Notes
Assign To:
Description:
DFIRM Study for
S_TEST_A queue
Job to Student01 training by Student
Started executing step Create Version
4/28/05 9:37:22 am
Step order and Description
1 Create A Version of the Data For the Job
2 Launch GeoPop Pro for LUT Population
3 Quality Check the Version For This Job
4 Reconcile and Post the Job Version
DFIRM Conve
Studies QC Admin
Curt Nelson
Ruth Olson
Sareth Sokhon
Tester 06 MIP
FEMA023P010
1 Job found in your jobs
October 28, 2004 2:35 pm

GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

Attribute Tool

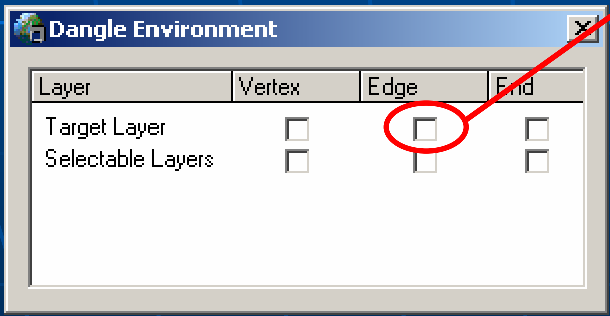


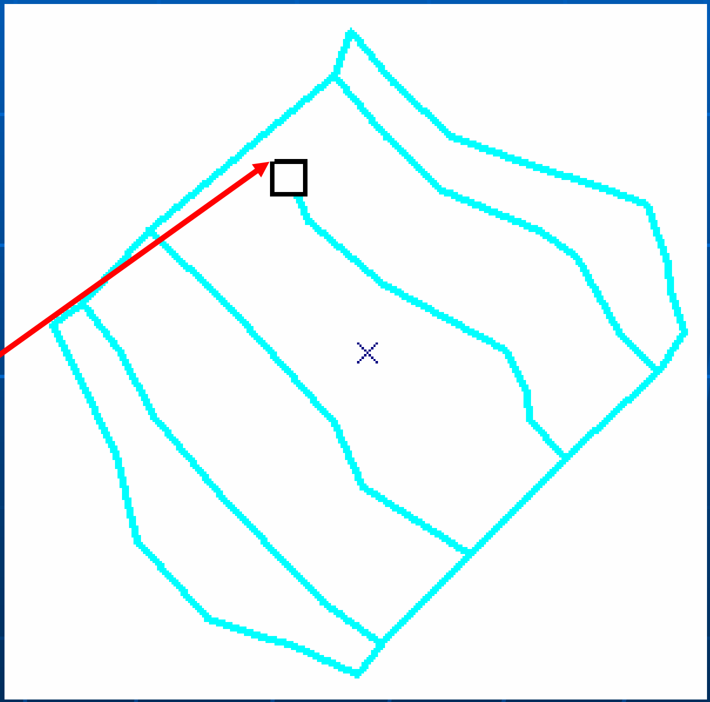


GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

Dangle Tool

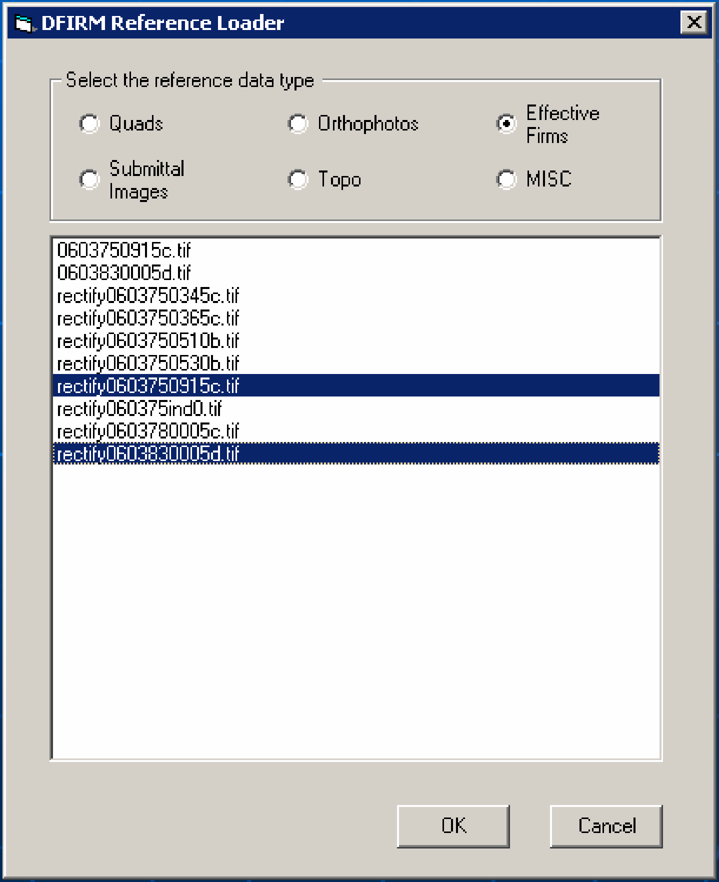




GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

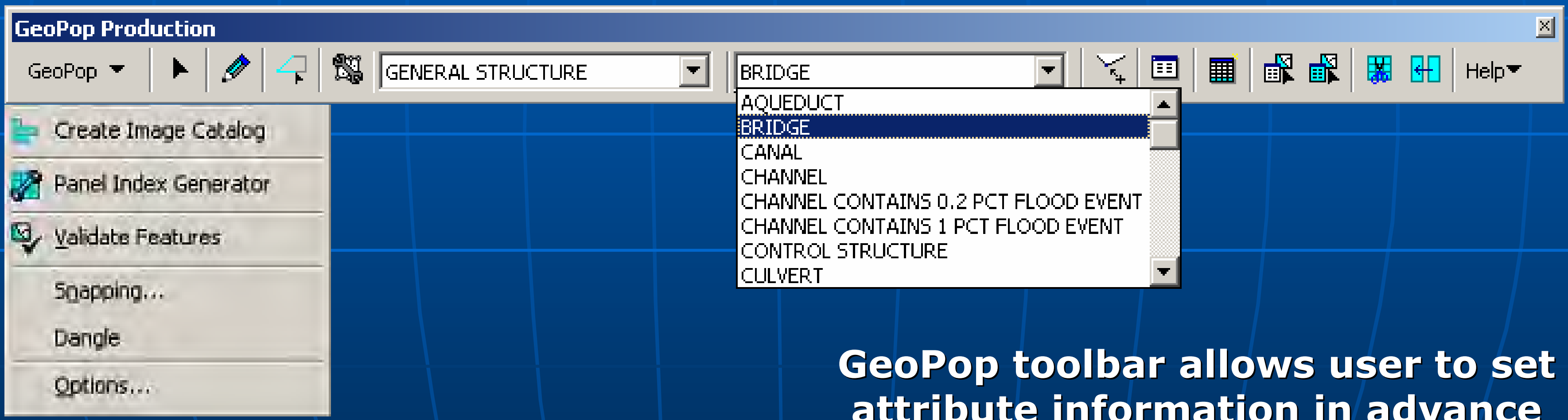
DFIRM Reference Loader Tool



GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

GeoPop Production Tool

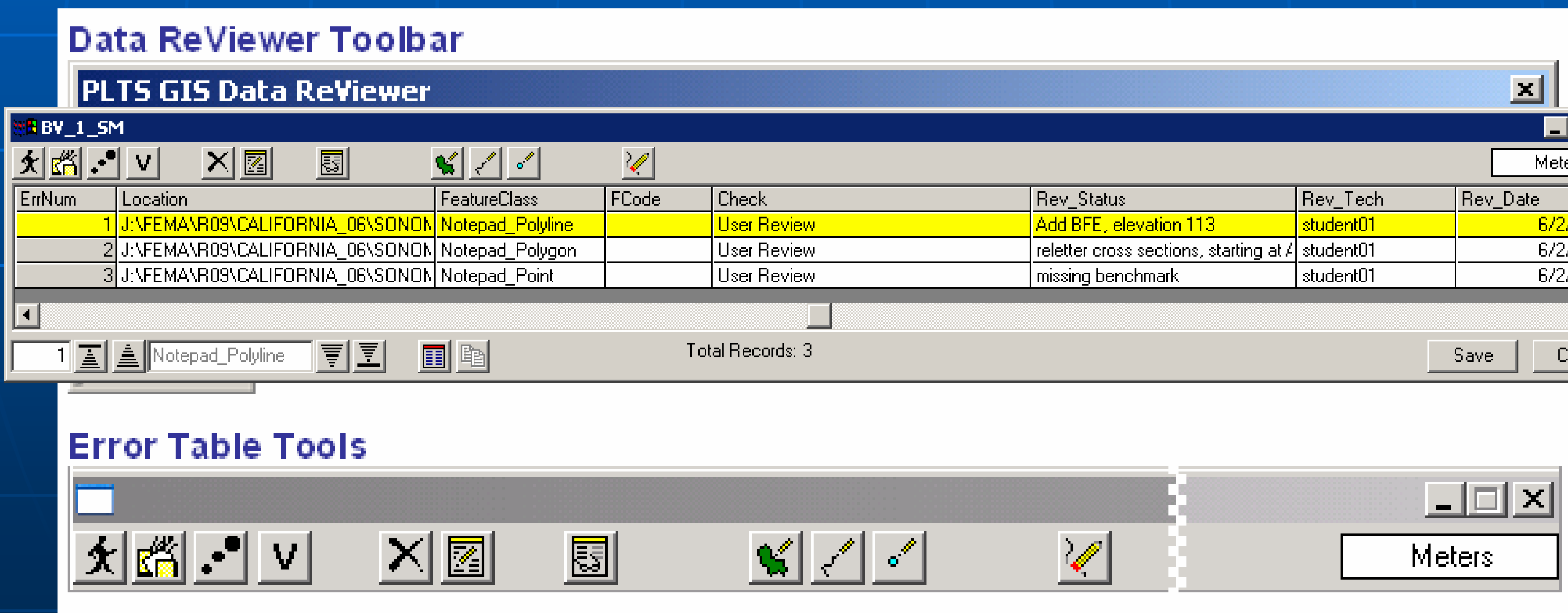


GeoPop toolbar allows user to set attribute information in advance

GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

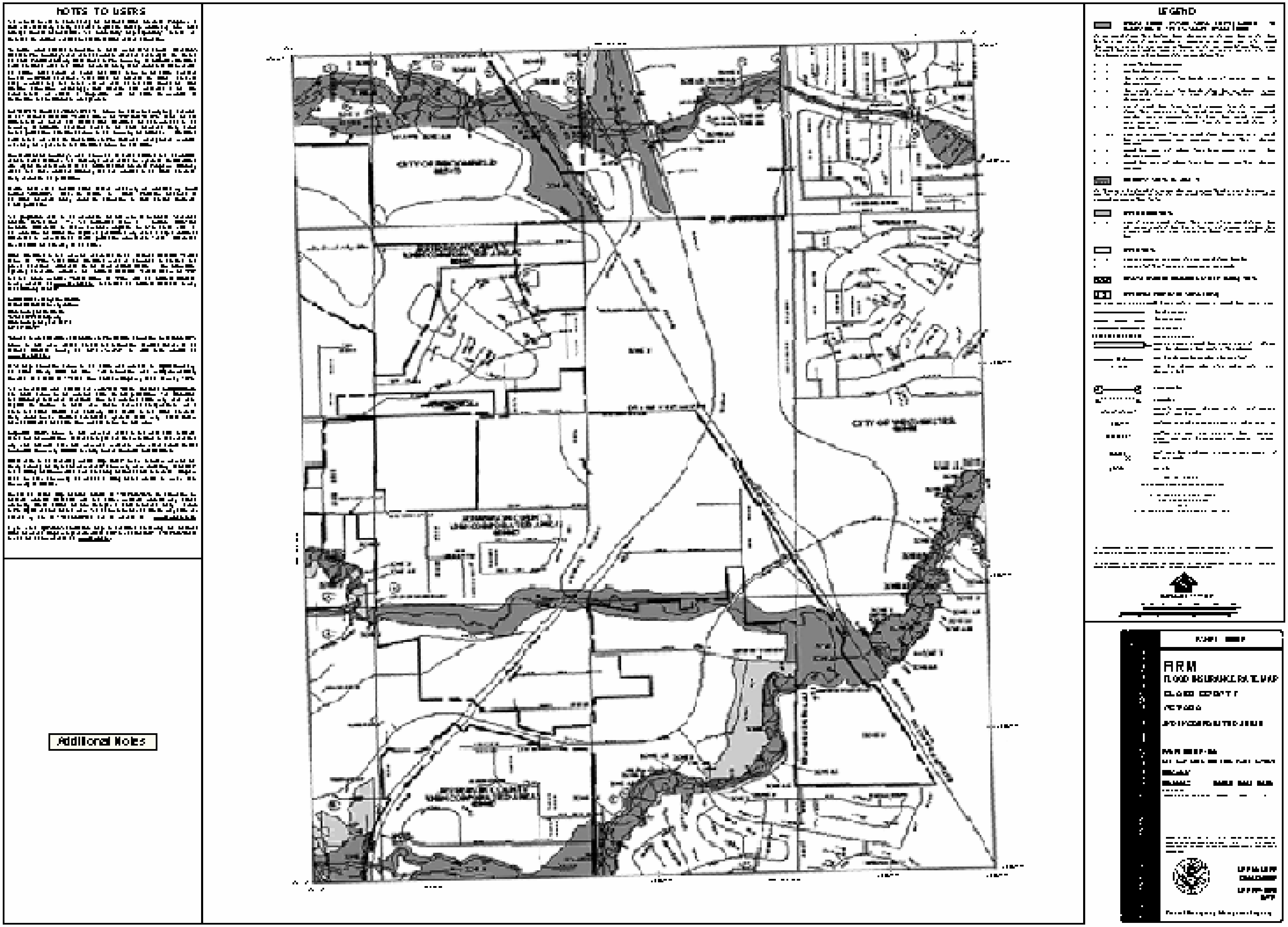
Data Reviewer Toolbars



GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

Map Production Tools


NOTES TO USERS
LEGEND
Additional Notes
FIRM
FLOOD INSURANCE RATE MAP

GIS & Surveying to Support FEMA Map Modernization

GIS Tools for Map Mod Studies

USACE recently coordinated DFIRM Tools and JTX training

- Training was conducted online
- No charge for class
- Instructor from FEMA MapMod Team
- 11 USACE District, and 1 Lab – 36 participants

We are considering a second training session in mid- to late-October 2005 … Please see me after this session if you are interested.

GIS & Surveying to Support FEMA Map Modernization

QUESTIONS

Mark Flick
615-736-7495
Mark.Flick@usace.army.mil

Broad Branch (Approximate study area)

Bridge ID#118 – "Broad Branch Road"

This bridge is shown on the effective FIRM to be within the Rock Creek 100-year floodplain, but the floodplain on Broad Branch appears to be only backwater as this bridge is not in any of the hydraulic models. LRH may desire to include this bridge in the pseudo HEC-RAS model for the approximate method study on Broad Branch. The map below illustrates the Broad Branch channel alignment through Ridge Road bridge then through Broad Branch Road bridge to the confluence with Rock Creek. (Mark Flick, CELRN, 615-736-7495)

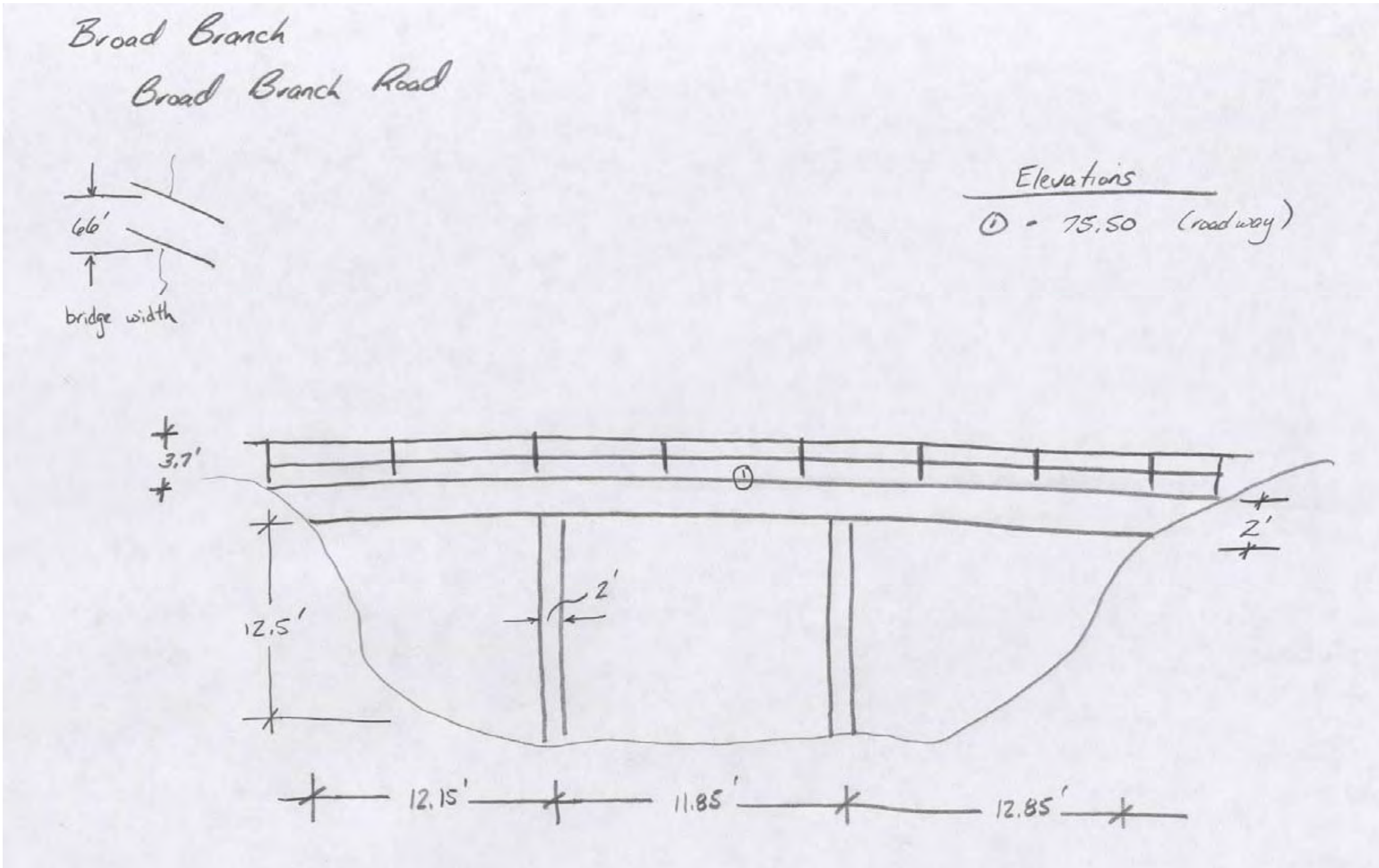
Photo below shows the upstream face of the Broad Branch Road bridge over Broad Branch.

Photo below shows the downstream face of the Broad Branch Road bridge over Broad Branch. There is a concrete shelf across the channel immediately downstream of this bridge. The drop off is 3-feet in height.

The photo below was taken from atop Broad Branch Road bridge looking upstream on Broad Branch.

The photo below was taken from atop Broad Branch Road bridge looking downstream on Broad Branch.

The following sketch provides general dimensions and elevation data for the Broad Branch Road bridge on Broad Branch.



Water Management in Iraq

Capability and Marsh Restoration

Fauwaz Hanbali

August 3, 2005

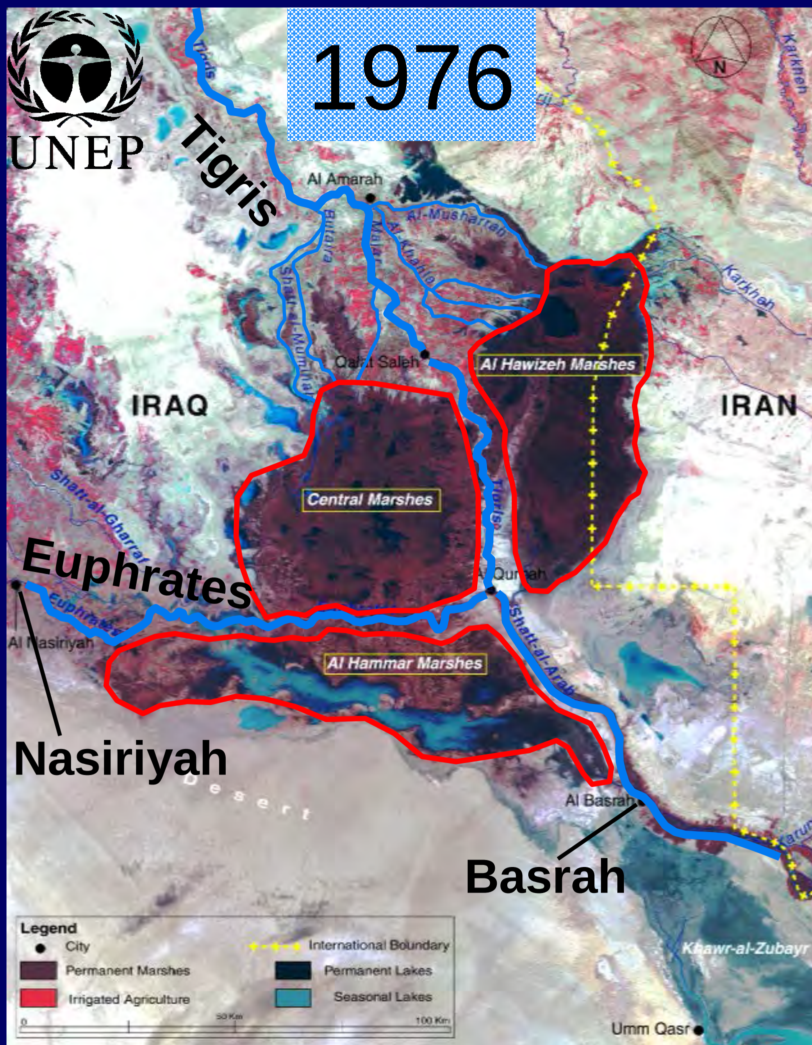
Iraq Ministry of Water Resources (MoWR)

- Rehabilitation and reconstruction of water management infrastructure.
- International donor and capacity building programs.
- Evaluation of available water resources, utilization, and management.
- USAID-sponsored Iraq Marshland Restoration Project (IMRP).

Tigris-Euphrates River Basin

- **Euphrates Basin**
  Thirty-two BCM; 95% Turkey, 5% Syria.
- **Tigris Basin**
  Fifty BCM; 20 BCM Turkey, 30 BCM tributaries.
- **System storage**
  Turkey – 90 BCM; Syria – 14 BCM; Iraq – 110 BCM.
- **Utilization**
  Iraq – 90% used for irrigation.

Drying of the Marshes

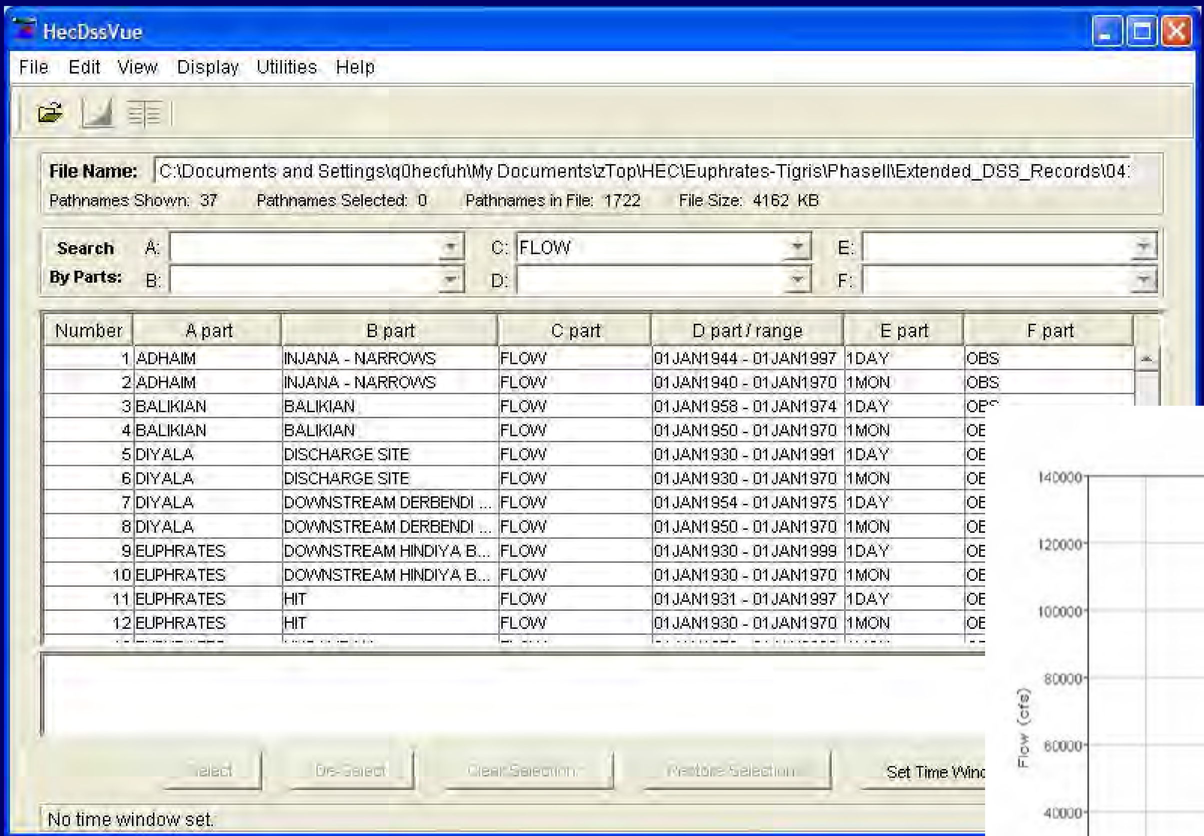


Images courtesy of UNEP/DEWA/GRID-Geneva
http://www.grid.unep.ch/activities/sustainable/tigris/2003_may.php

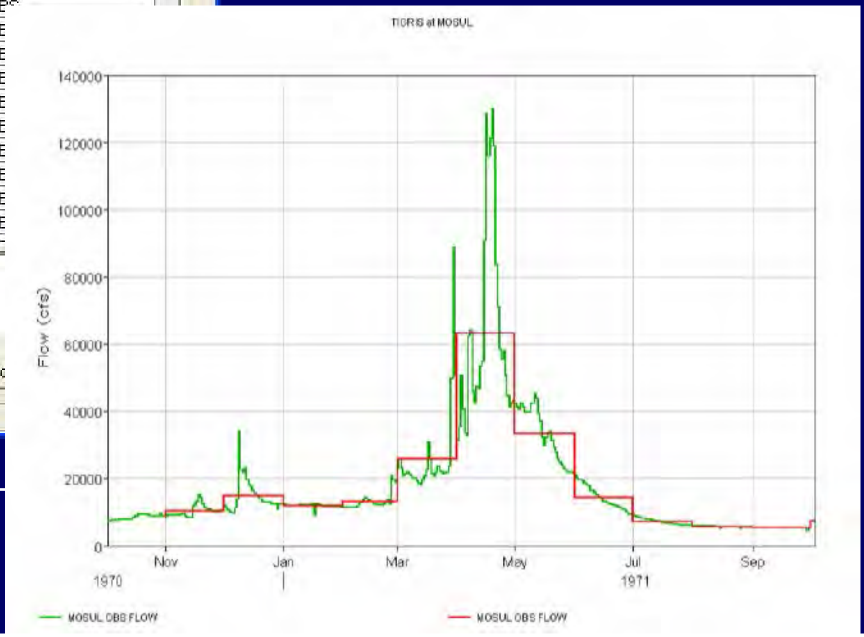
Restoration and Capacity Building support – Flow Data

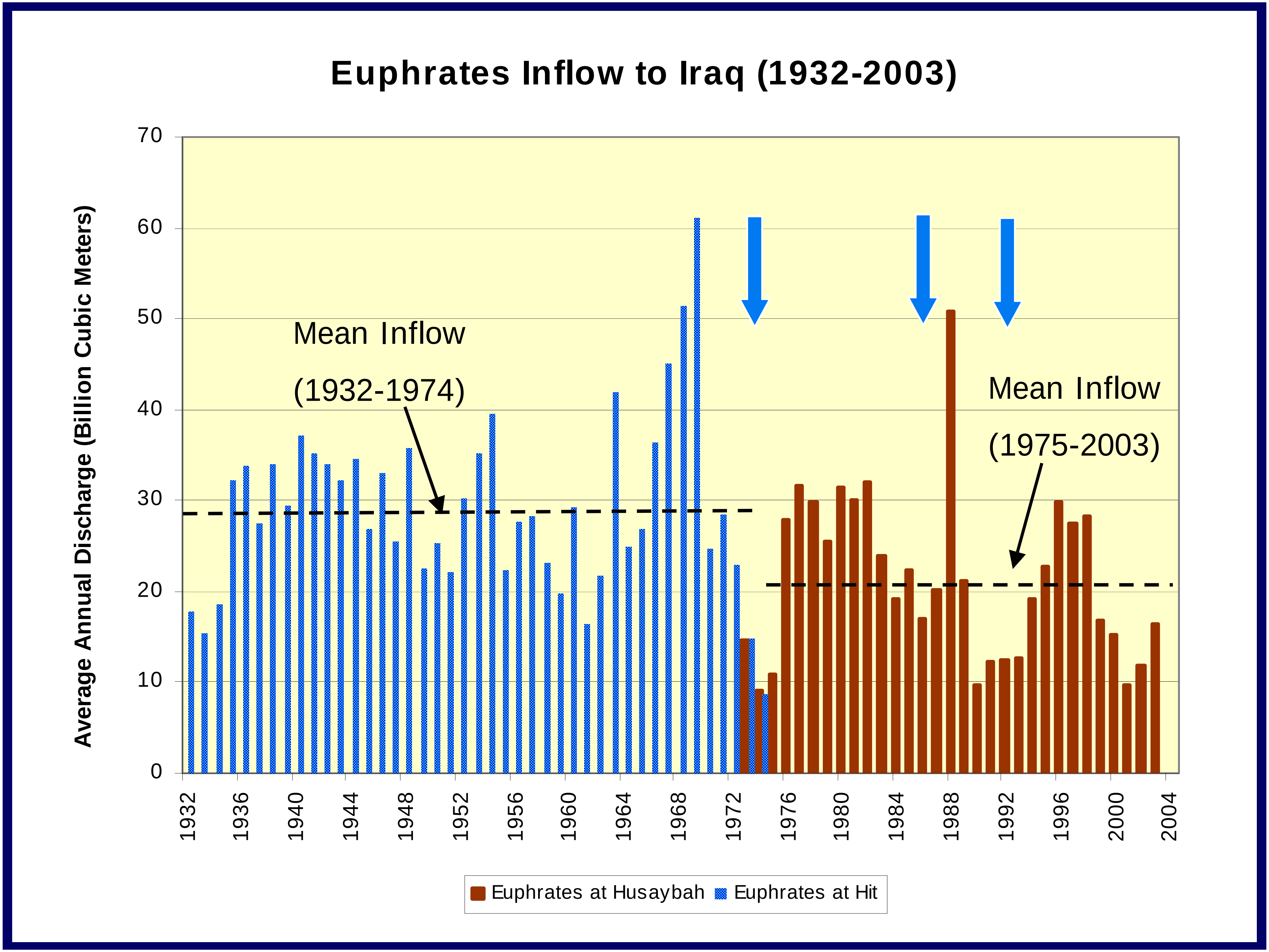
- Reconstruct streamflow data for gages.
  - Retrieve historic – archives through mid-70's.
  - Fill in missing, add new data through 2004.
  - QA/QC and place in HEC-DSS database.
- Develop scenario data sets.
  - Logic for headwater and local inflow to model.
  - Unimpaired (essentially 1930 system status).
  - Present development (2004).
  - A likely future scenario circa 2030+-.

Tigris-Euphrates Database



- HEC-DSSVue archived records of observed:
  - Stream flows
  - Reservoir elevations
  - Reservoir outflows



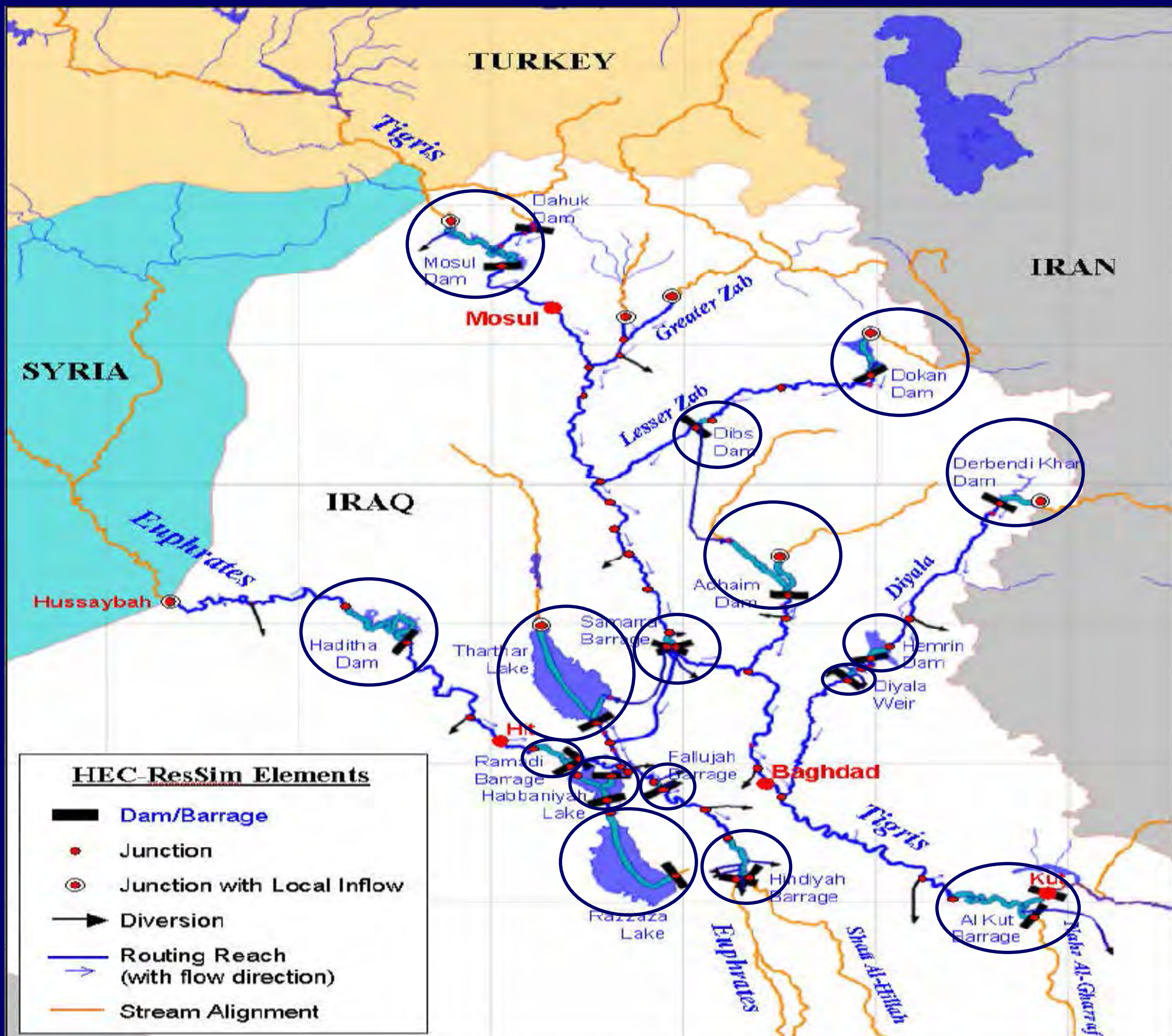


Euphrates Inflow to Iraq (1932-2003)
Average Annual Discharge (Billion Cubic Meters)
0
10
20
30
40
50
60
70
Mean Inflow
(1932-1974)
Mean Inflow
(1975-2003)
1932
1936
1940
1944
1948
1952
1956
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
Euphrates at Husaybah
Euphrates at Hit

Restoration and Capacity Building Reservoir Simulation Model

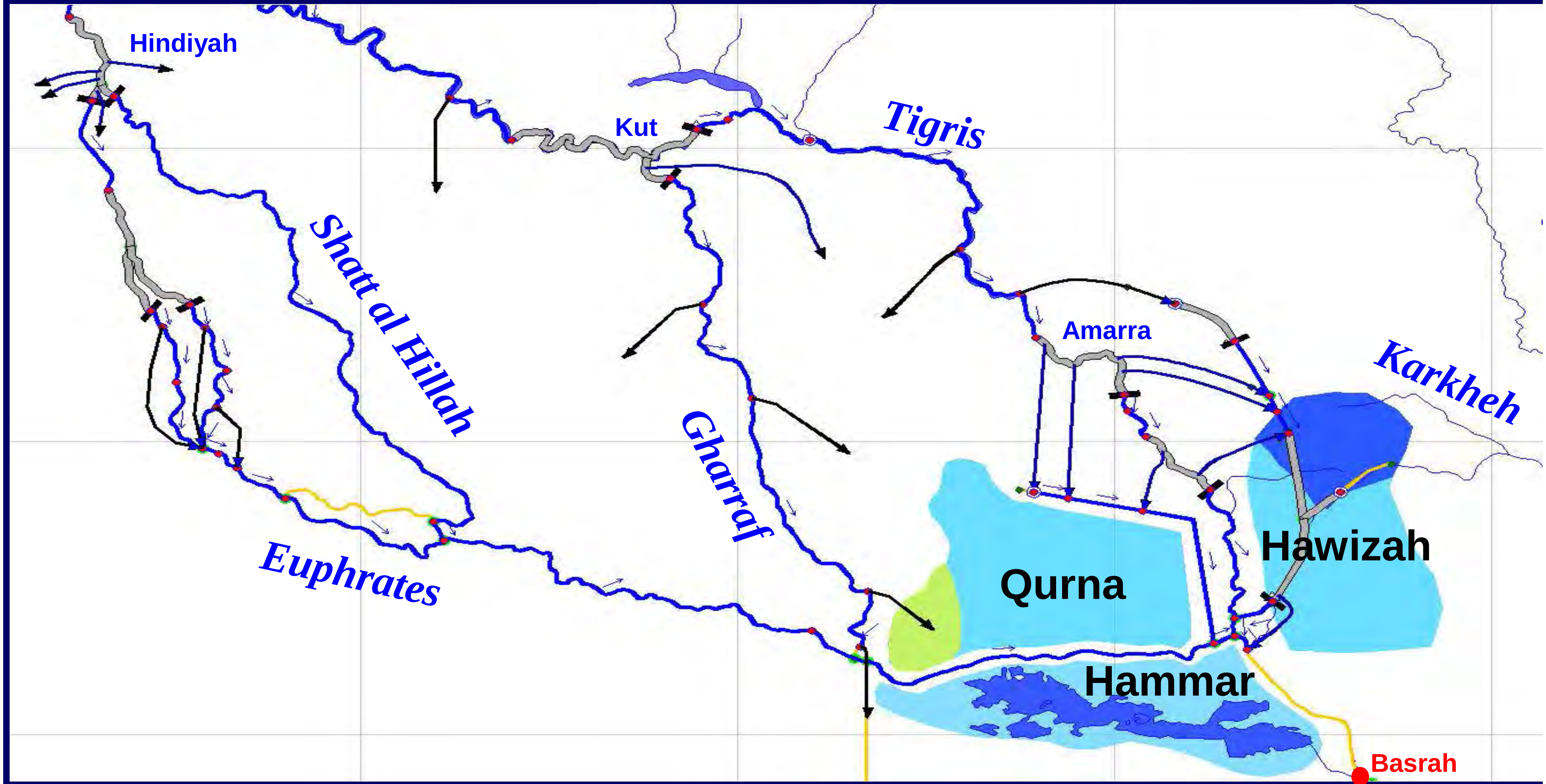
- Model development in partnership with Iraq Ministry for Water Resources (MoWR)
- HEC-ResSim Reservoir System Analysis software
- Rule-based, multi-purpose, seasonal reservoir operation
- Complex network of interconnected reservoirs, river reaches, and control points
- Scenario simulations
- Train/transfer model development and application skills to Iraqi engineers

Reservoir Simulation Model



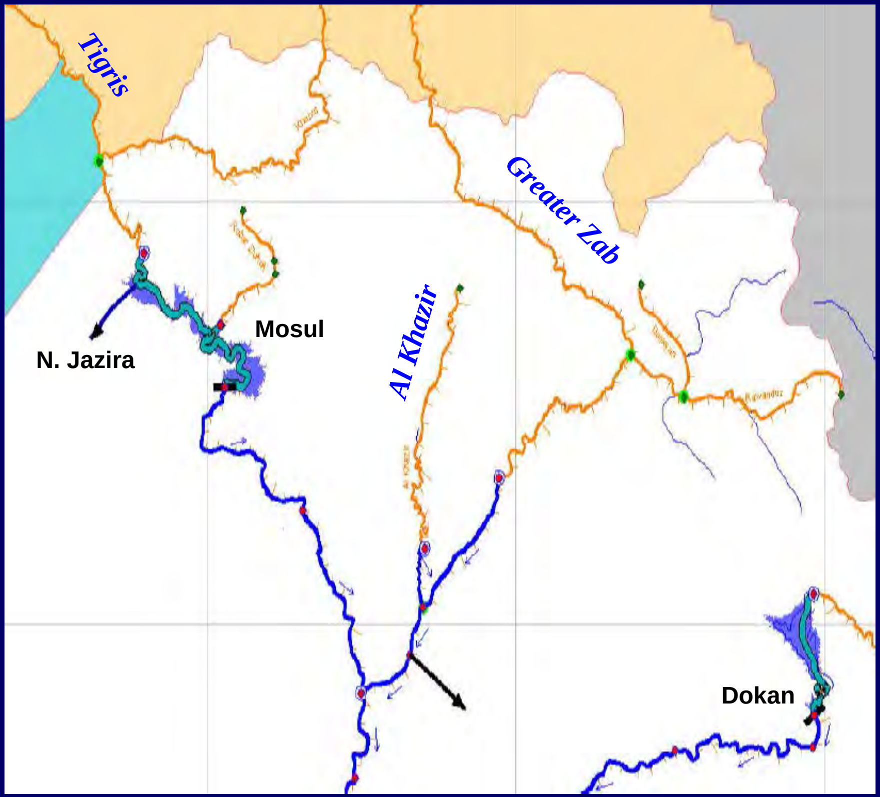
- Major Dams
- Off-stream storage reservoirs
- Low-head diversion structures "Barrages"
- Irrigation Diversions
- Delivery points to the Marshes

Lower Basin

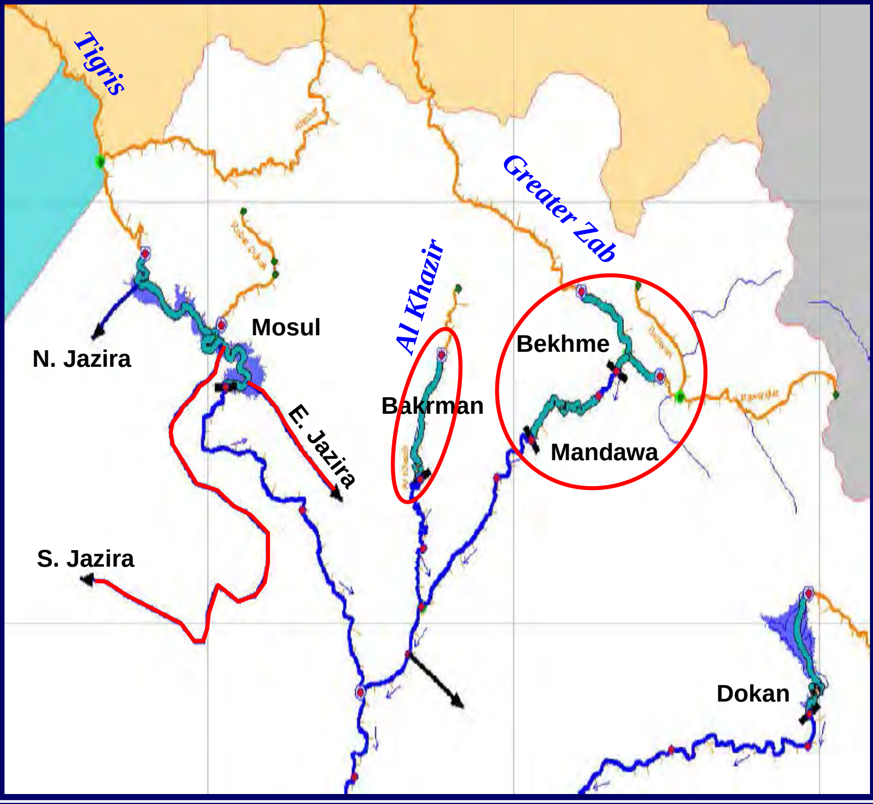

Hindiyah
Kut
Tigris
Shatt al Hillah
Amarra
Karkheh
Gharraf
Hawizah
Qurna
Euphrates
Hammar
Basrah

Future Development

Existing Conditions



Future Conditions

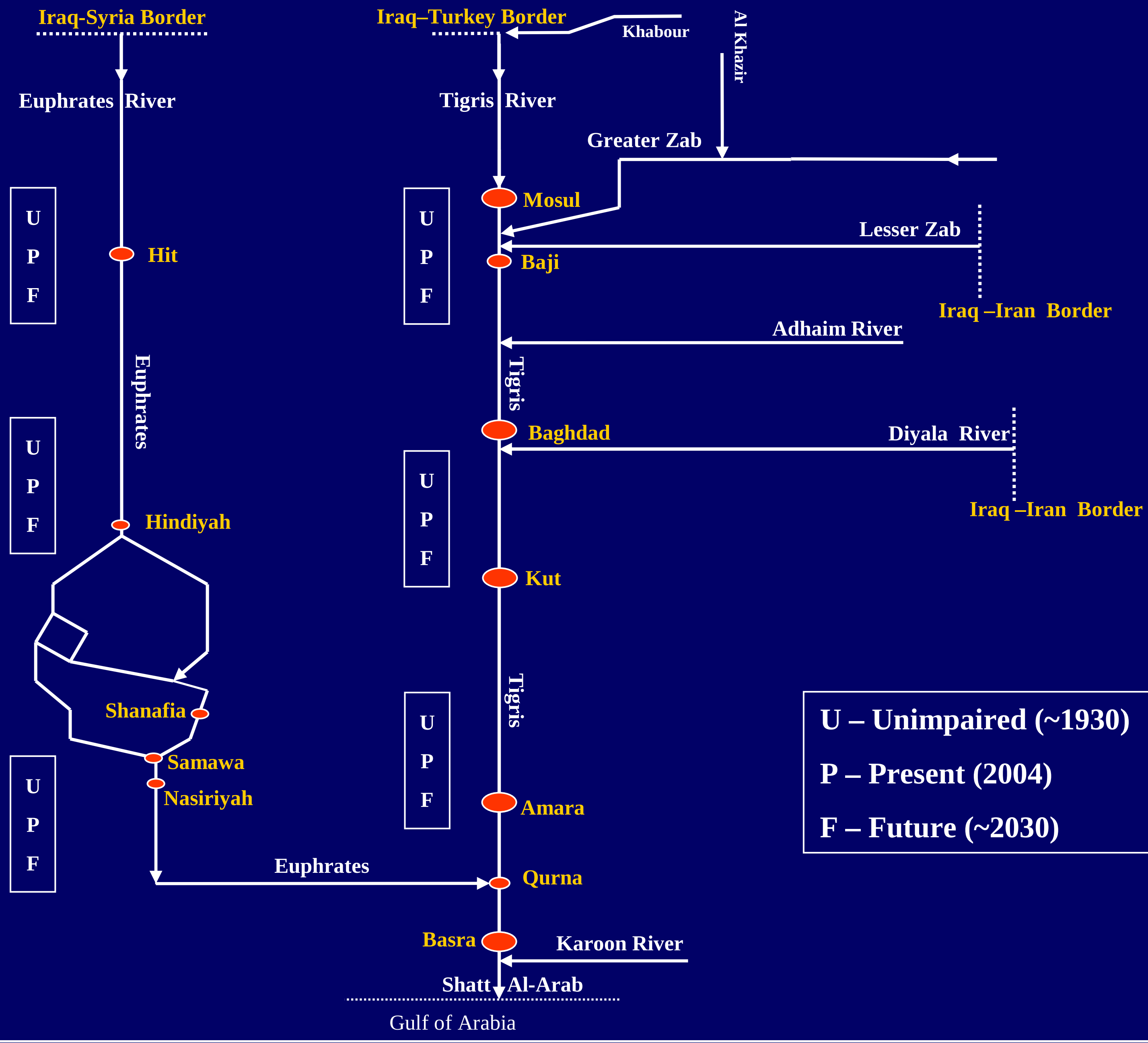


Modeling Scenarios

- Unimpaired (1930 level of development)
  - Simulate river system with regulation and depletion effects of projects that only existed in 1930
- Impaired (2004 level of development)
  - Simulate river system with regulation and depletion effects of projects that currently exist in 2004
- Impaired (2030 level of development)
  - Simulate river system with regulation and depletion – and including Marsh flow demand – effects of future projects that will exist in 2030

Tigris-Euphrates, Iraq

Water Balance



Capacity Building Activities

- USACE – ERDC led project, PCO sponsored.
- On-site, in US/Europe, study tours.
- Management-level training and tours.
- Technical training.
  - GIS, dam safety, water management.
  - Stream gaging.
  - HEC models.
- International professional and interagency relationship building.

HEC Key Activities

- Prepare standardized flow data sets.
- Perform ResSim scenario simulations.
- Conduct capacity building training under USACE and USAID programs.
- Transfer data and models to MoWR.
- Assist MoWR, USAID in further studies.

HEC Points of Contact

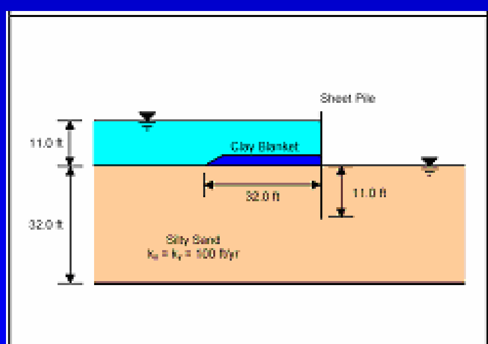
- Darryl Davis, Director
  darryl.w.davis@usace.army.mil

- Matt McPherson, Senior Hydraulic Engineer
  matthew.m.mcpherson@usace.army.mil

- Fauwaz Hanbali, Hydraulic Engineer
  fauwaz.u.hanbali@usace.army.mil

SEEP2D & GMS:

Simple Tools for Solving a Variety of Seepage Problems



Clarissa Hansen, ERDC-CHL

Fred Tracy, ERDC-ITL

Eileen Glynn, ERDC-GSL

Cary Talbot, ERDC-CHL

Earl Edris, ERDC-CHL

SEEP2D

- **2-D finite element seepage model**
- **Written by Fred Tracy, USACE-ERDC-ITL, published 1973**
- **Late 1970s – Dr. Tracy published groundbreaking work on visualization and pre- and post-processing for FEM models.**
- **Simple, mesh-based interface for SEEP2D first included in GMS v2.1, 1998.**
- **GMS v6.0 (2005) has a newly updated map-based interface**

NEW!

SEEP2D Applications

- Isotropic/anisotropic soil properties
- Confined/unconfined profile models
- Saturated/unsaturated flow for unconfined profile models
- Confined flow for plan (areal) models
- Flow simulation in the saturated and unsaturated zones
- Heterogeneous soil conditions
- Axisymmetric models such as flow from a well
- Drains

SEEP2D cannot simulate…

- **Transient or time varying problems**
- **Unconfined plan (areal) models**

Governing Equation

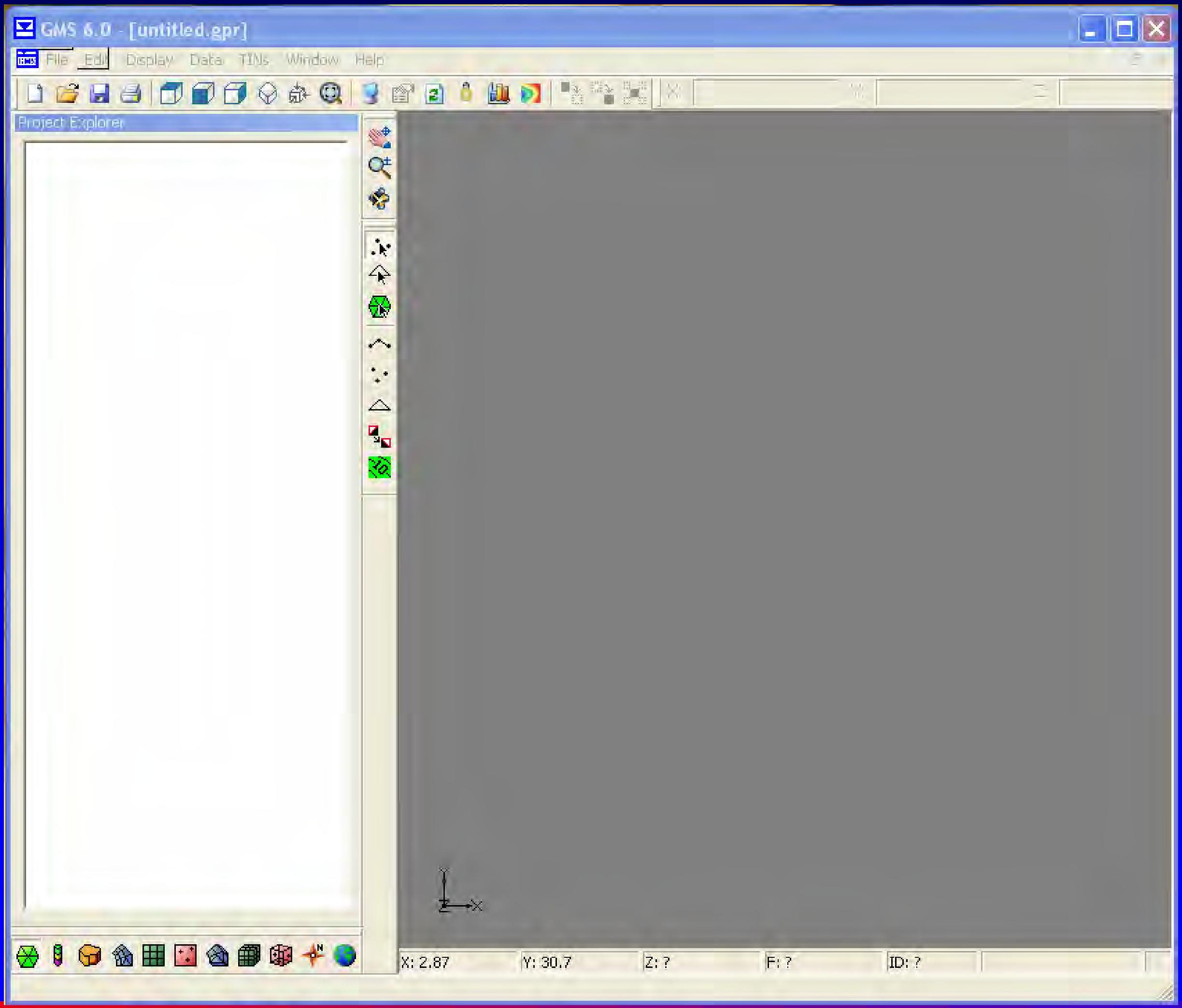
$$\nabla \bullet (K \bullet \nabla h) = 0$$

$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x} + K_{xy}\frac{\partial h}{\partial y}\right) + \frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y} + K_{yx}\frac{\partial h}{\partial x}\right) = 0$$

h=total head (elevation + pressure head)

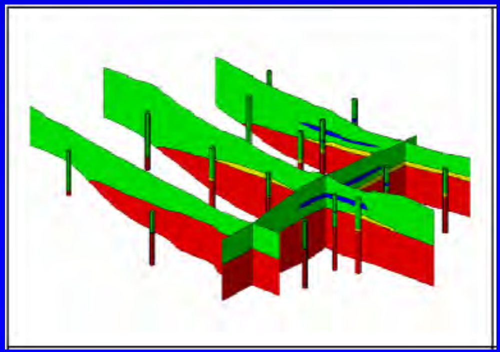
K=hydraulic conductivity

Department of Defense Groundwater Modeling System (GMS)



Groundwater Modeling System (GMS)

- 3D sub-surface characterization for groundwater modeling
- Supports 2D and 3D FEM, FDM, and analytic codes
- Incorporates advanced 3D post-processing visualization tools



- Supported Models
  - MODFLOW2000
  - MODPATH
  - FEMWATER
  - WASH123D
  - ADH
  - SEEP2D
  - ART3D
  - SEAM3D
  - MT3DMS
  - RT3D
  - UTCHEM
  - MODAEM

GMS Quick Facts

- First version released late 1994
- Current version is v6.0
- Developed by consortium of federal, academic & private concerns
- Graphical interface by EMRL at BYU
- Over 700 Fed Gov't users and thousands more in over 90 countries

Obtaining GMS

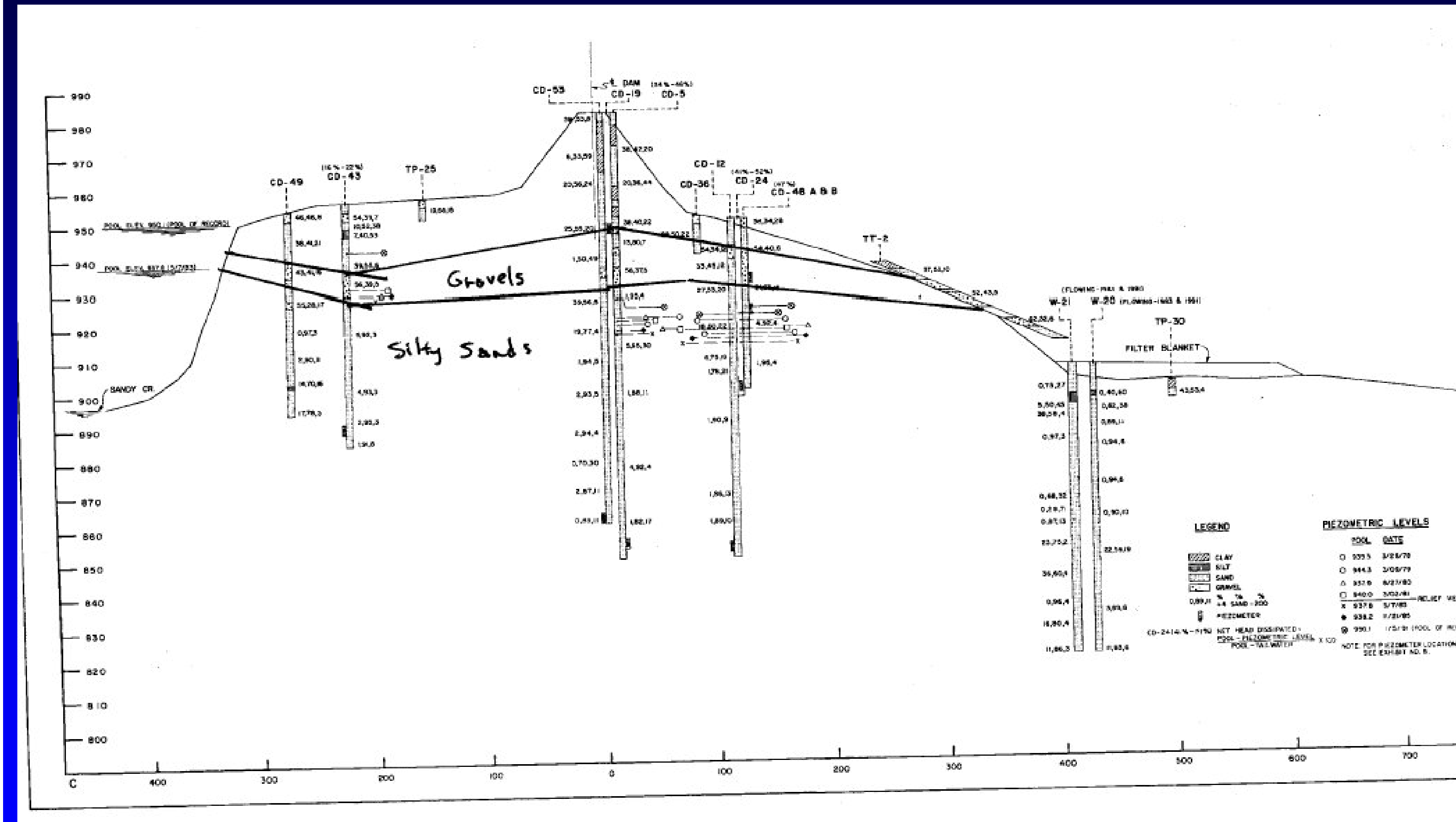
- **Employees of DoD, DoE, NRC, EPA and their on-site contractors can obtain free licenses for GMS at** http://chl.erdc.usace.army.mil/gms**.**
- **Groundwater Modeling Technical Support Center at ERDC handles GMS user support and training.**
- **Others can purchase licenses by contacting EMS-I at** http://www.ems-i.com**.**

The GMS download comes with the SEEP2D executable and source code, two SEEP2D tutorials and the SEEP2D documentation.

Setting Up a SEEP2D Simulation in GMS

1. Set up Conceptual Model
    a) Set up domain
    b) Assign soil properties
    c) Redistribute vertices
    d) Assign boundary conditions
2. Build Computational Mesh
3. Map Boundary Conditions
4. Run
5. View Results

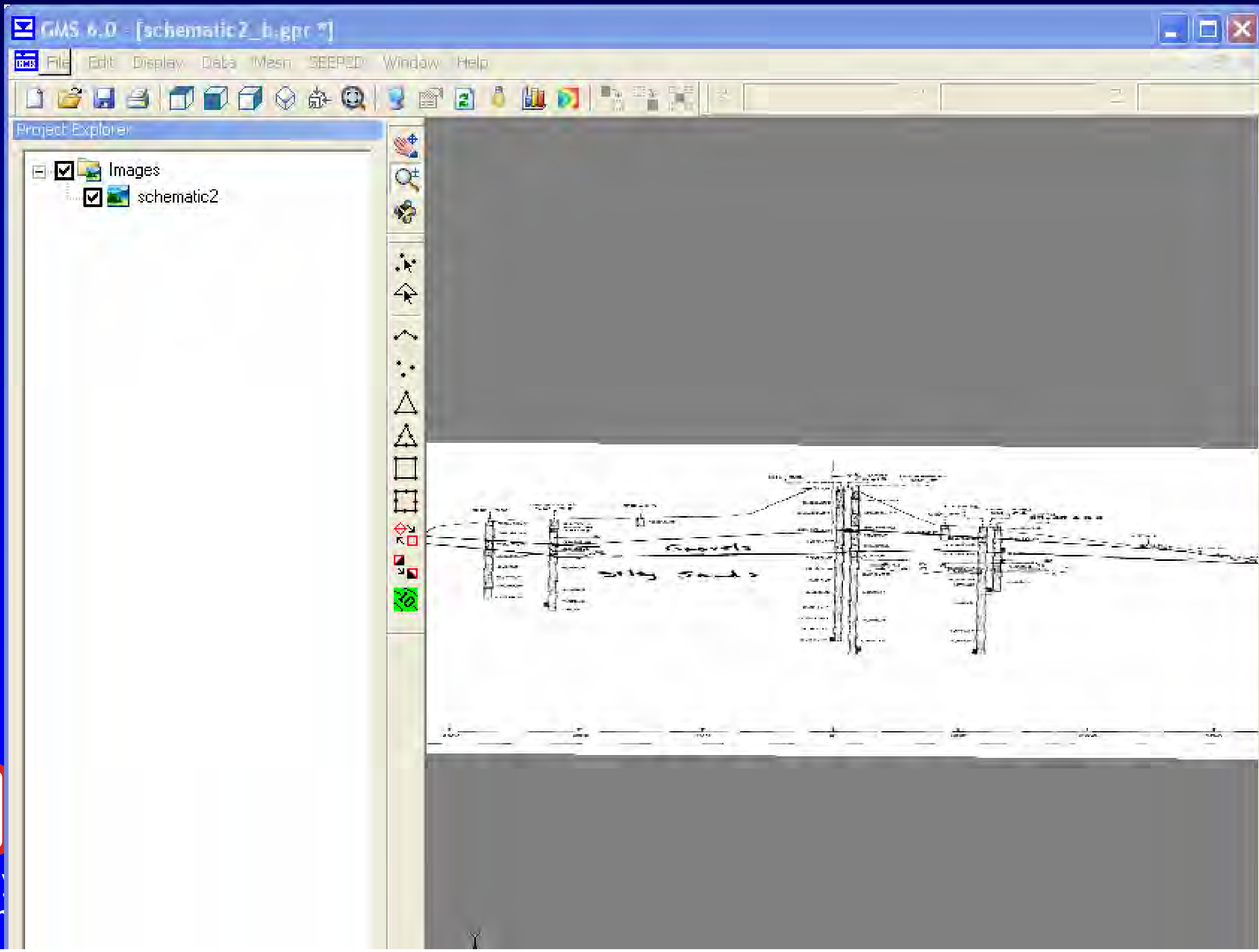
Sample Problem



US Army Corps
of Engineers

Engineer Research and Development Center

Import Image



US Army
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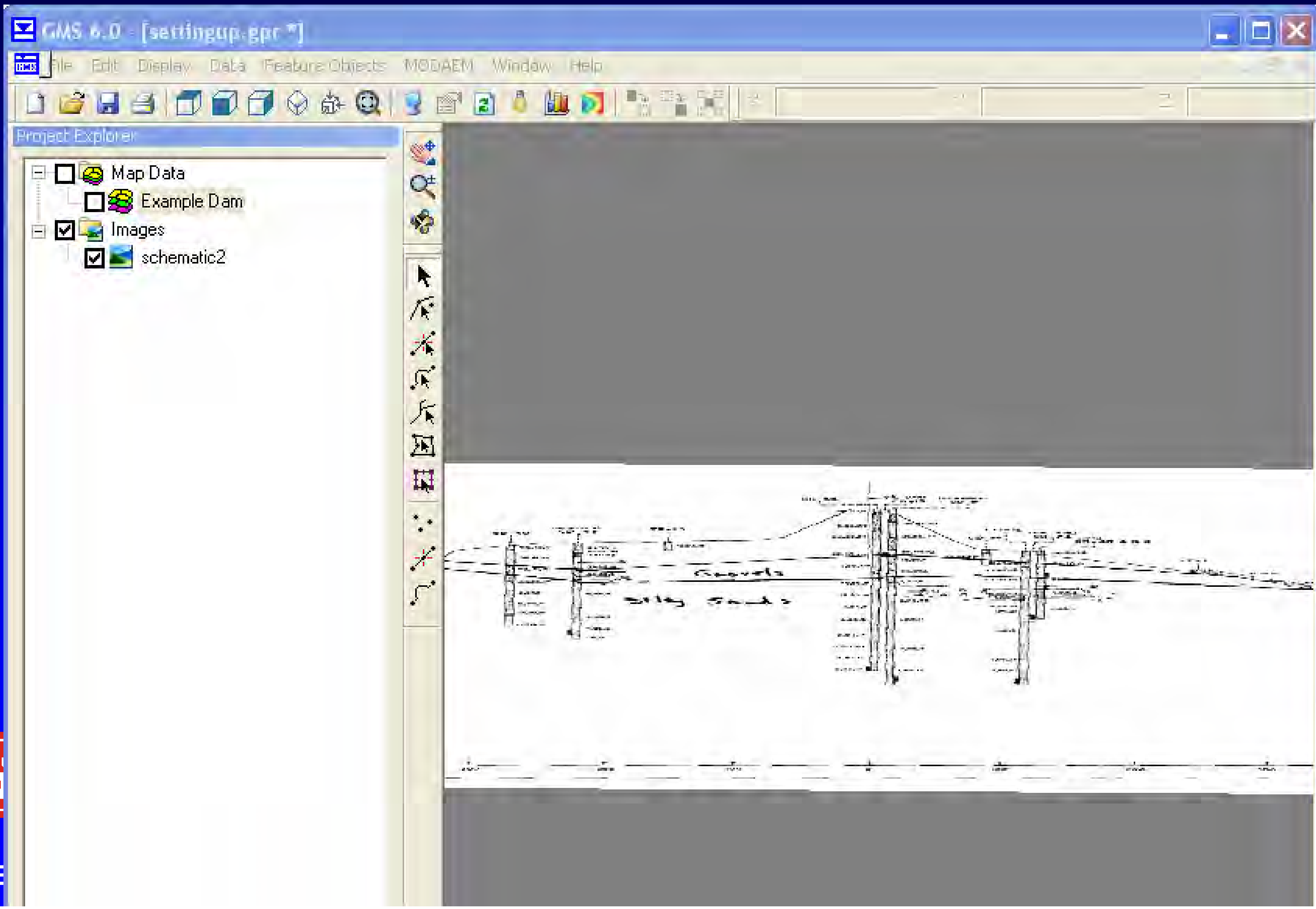
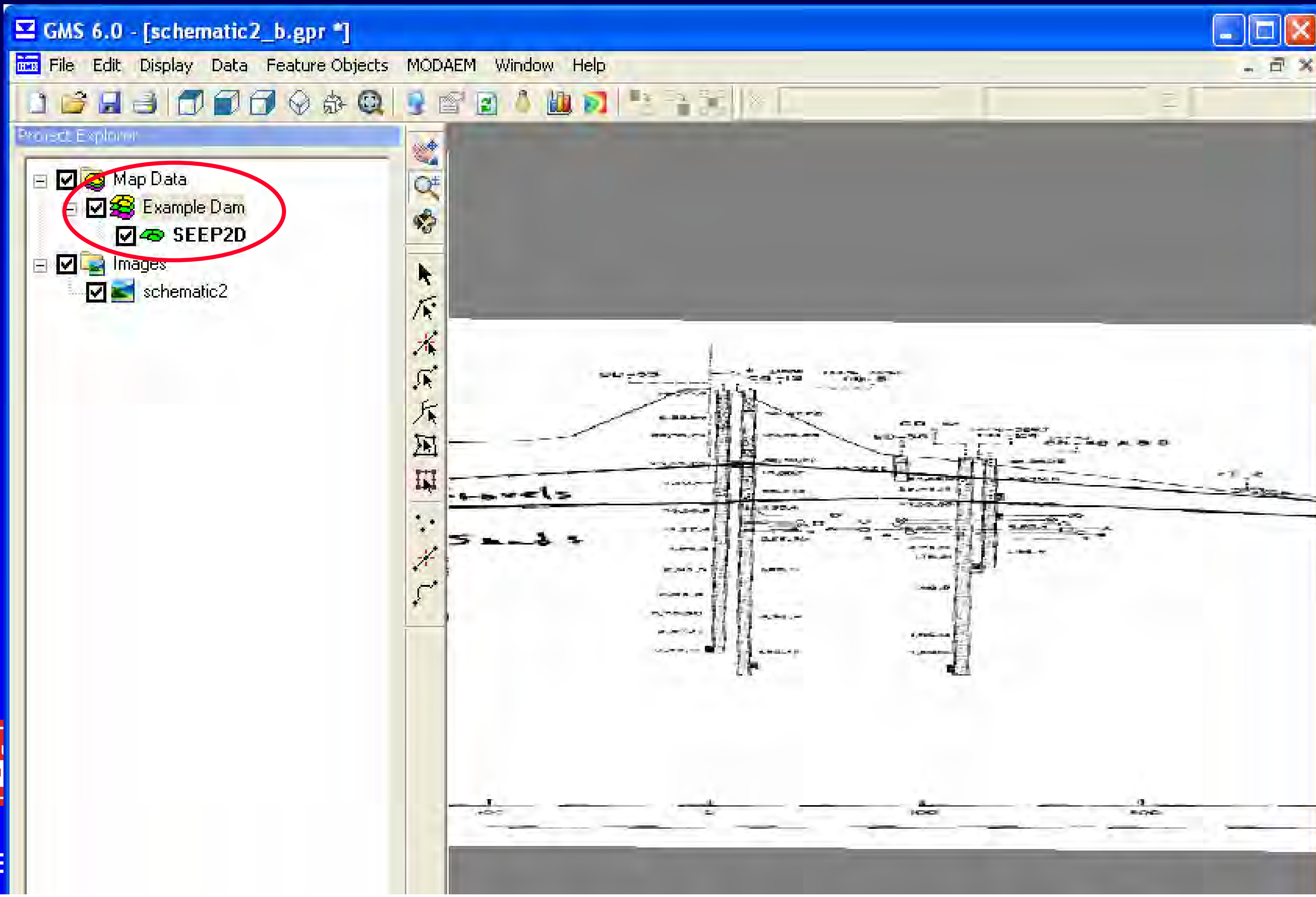
Center

Create Conceptual Model



Create Coverage



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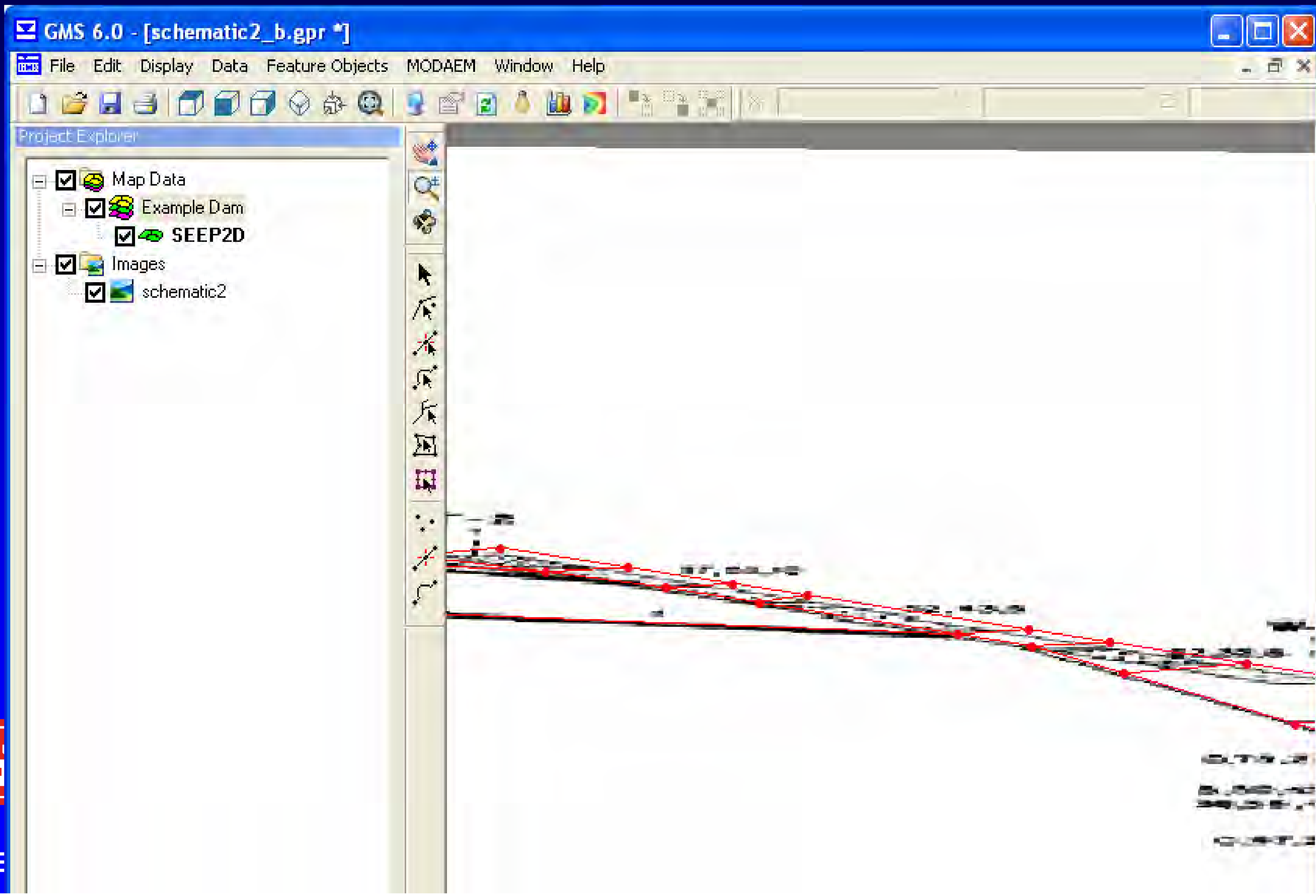
Set Up Domain



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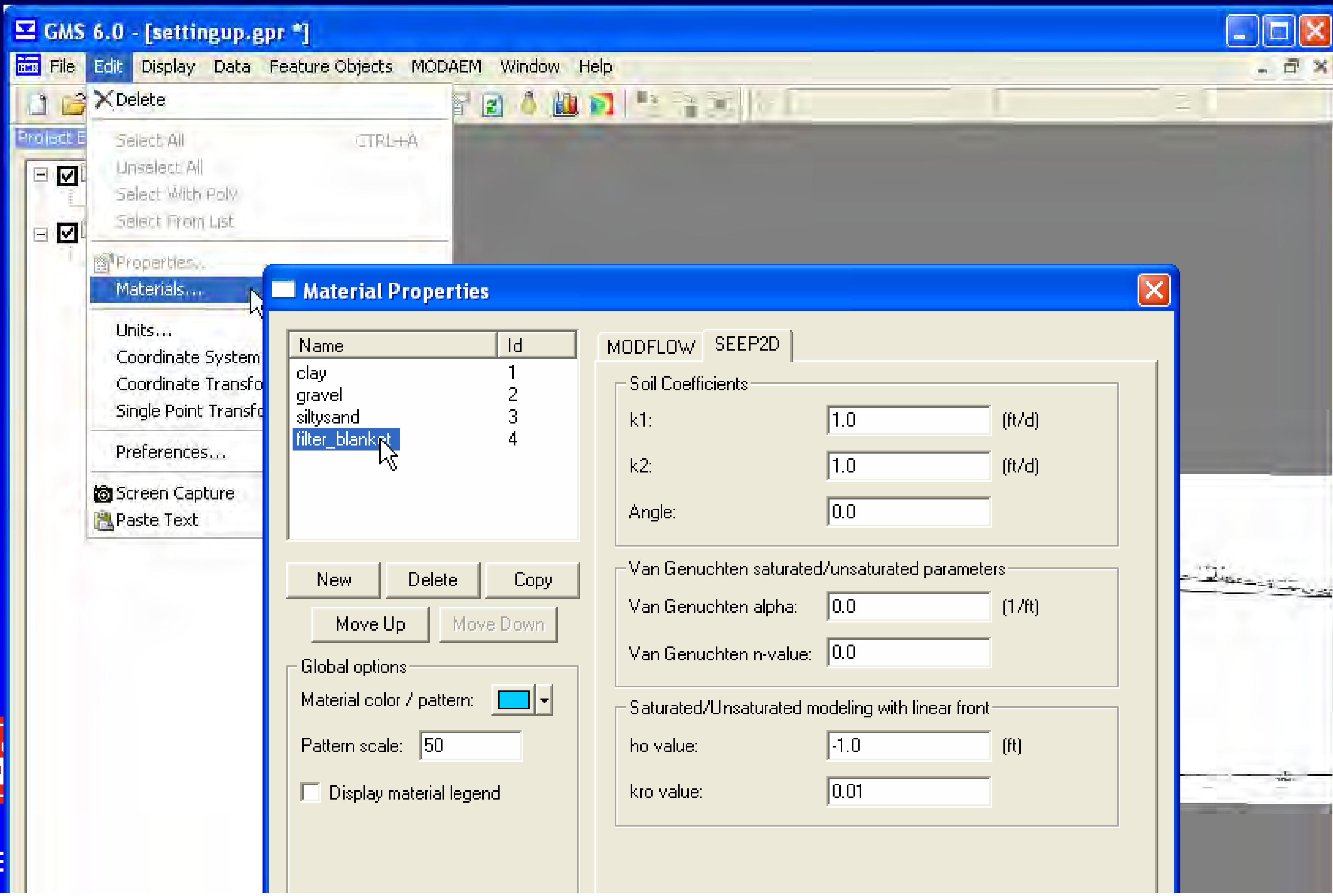
Create Material Types



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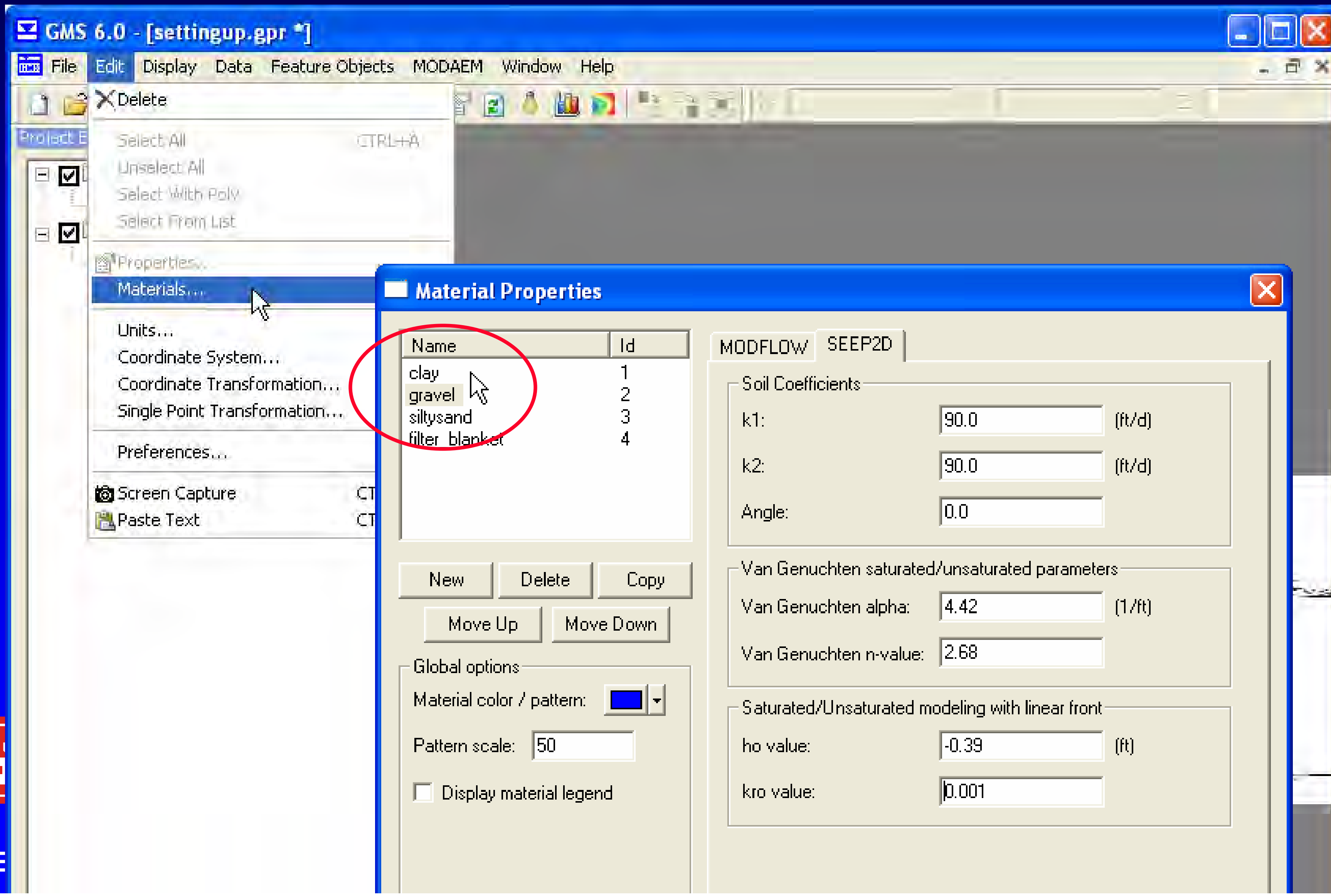
Assign Material Properties



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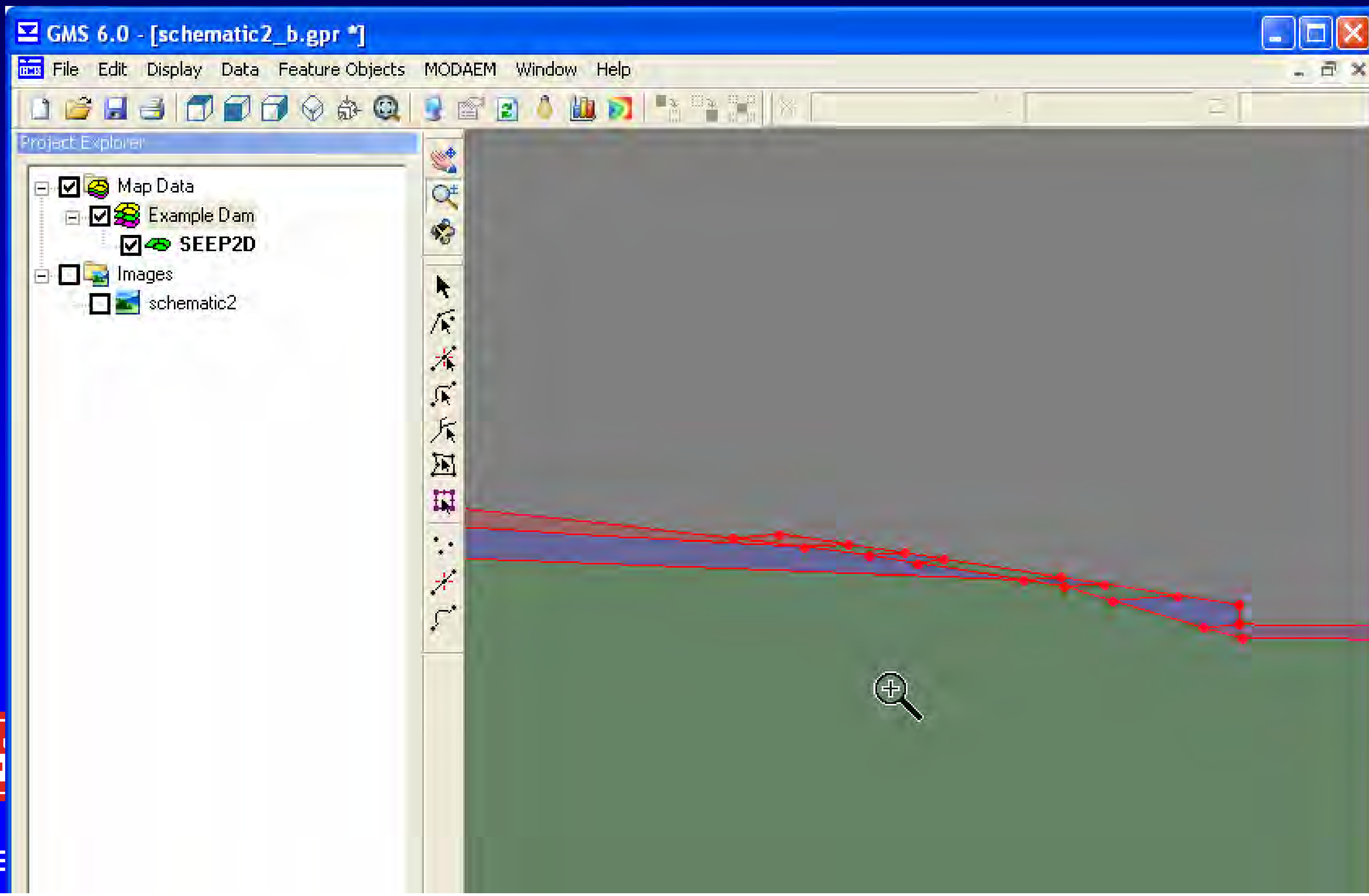
Assign Materials to Polygons



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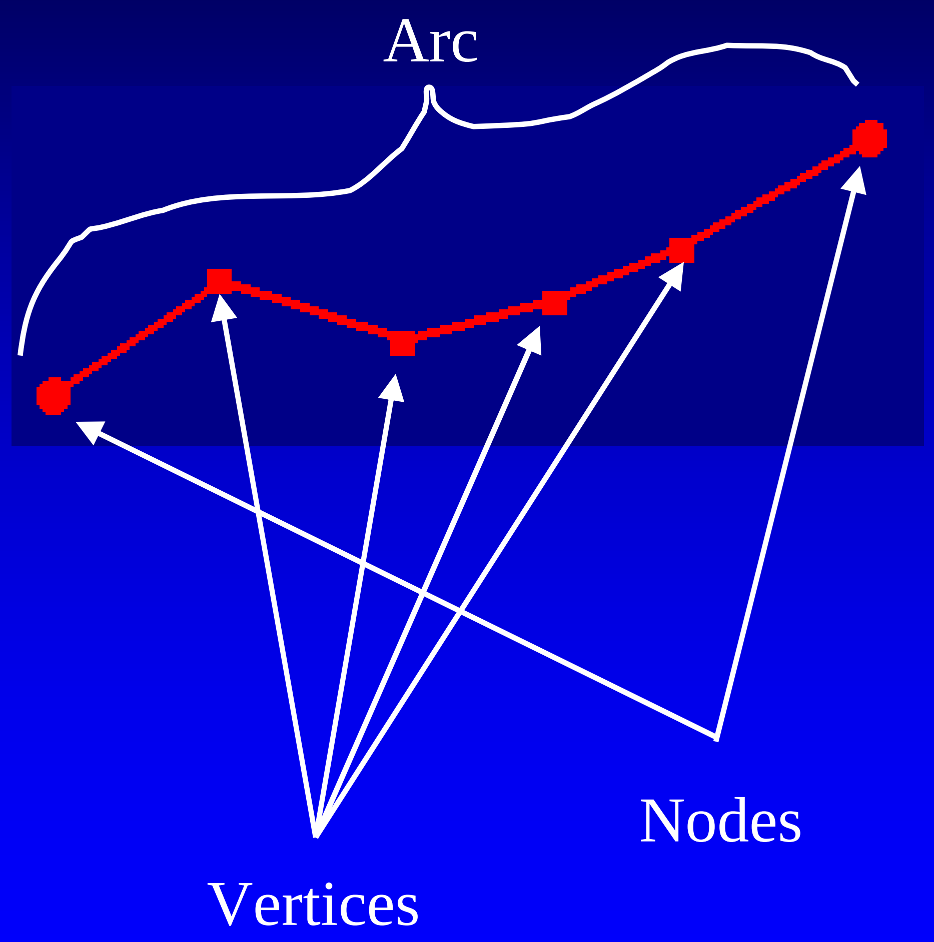
Redistribute Vertices



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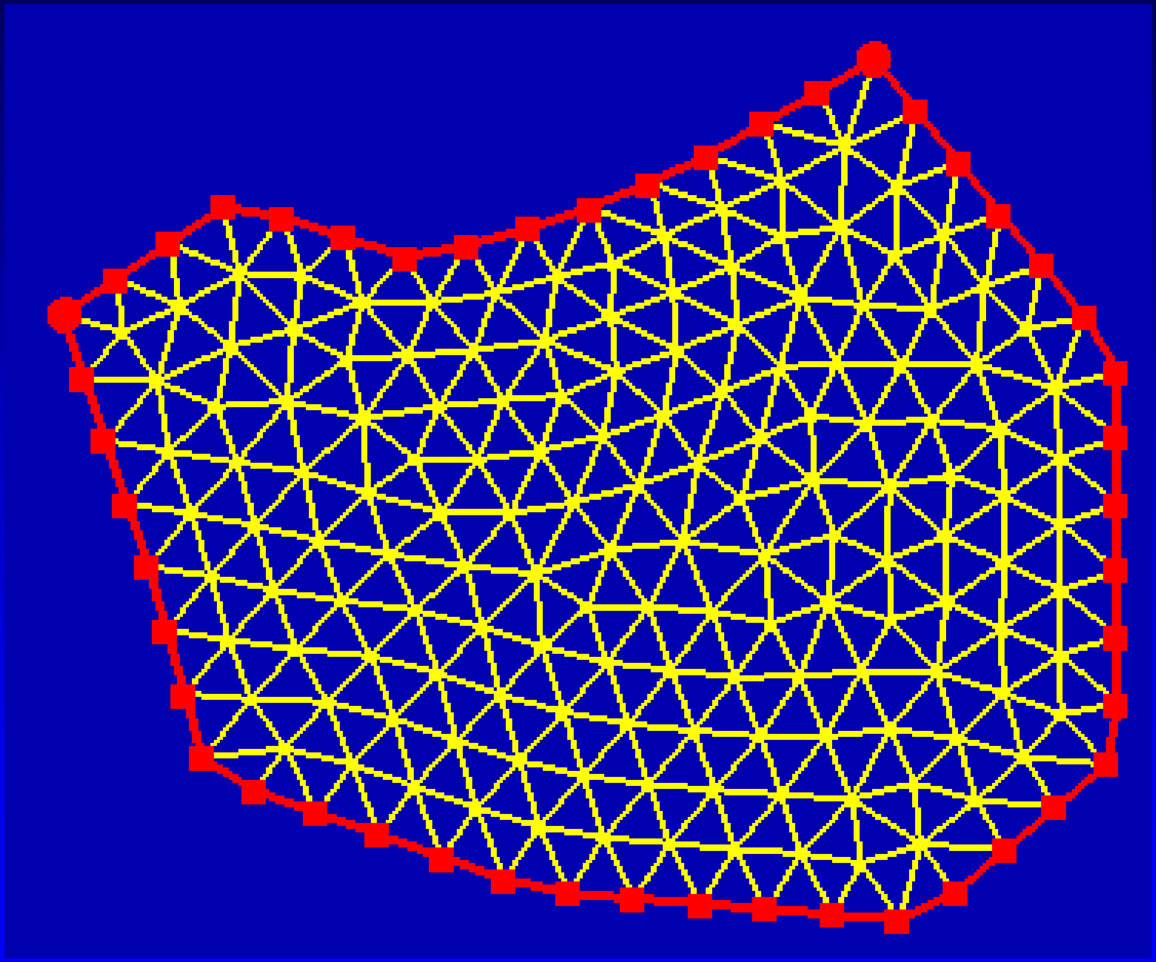

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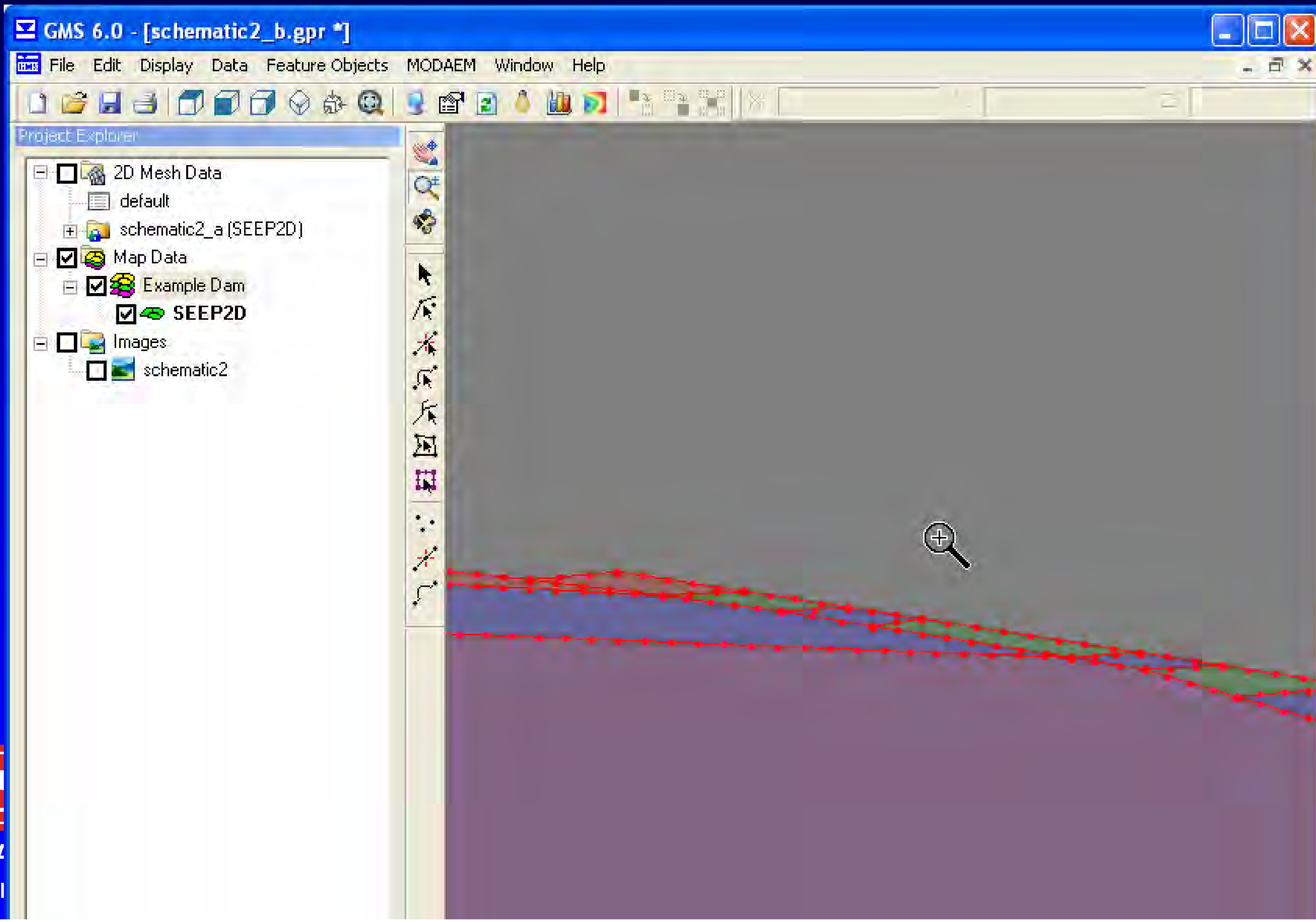
Redistribute Vertices



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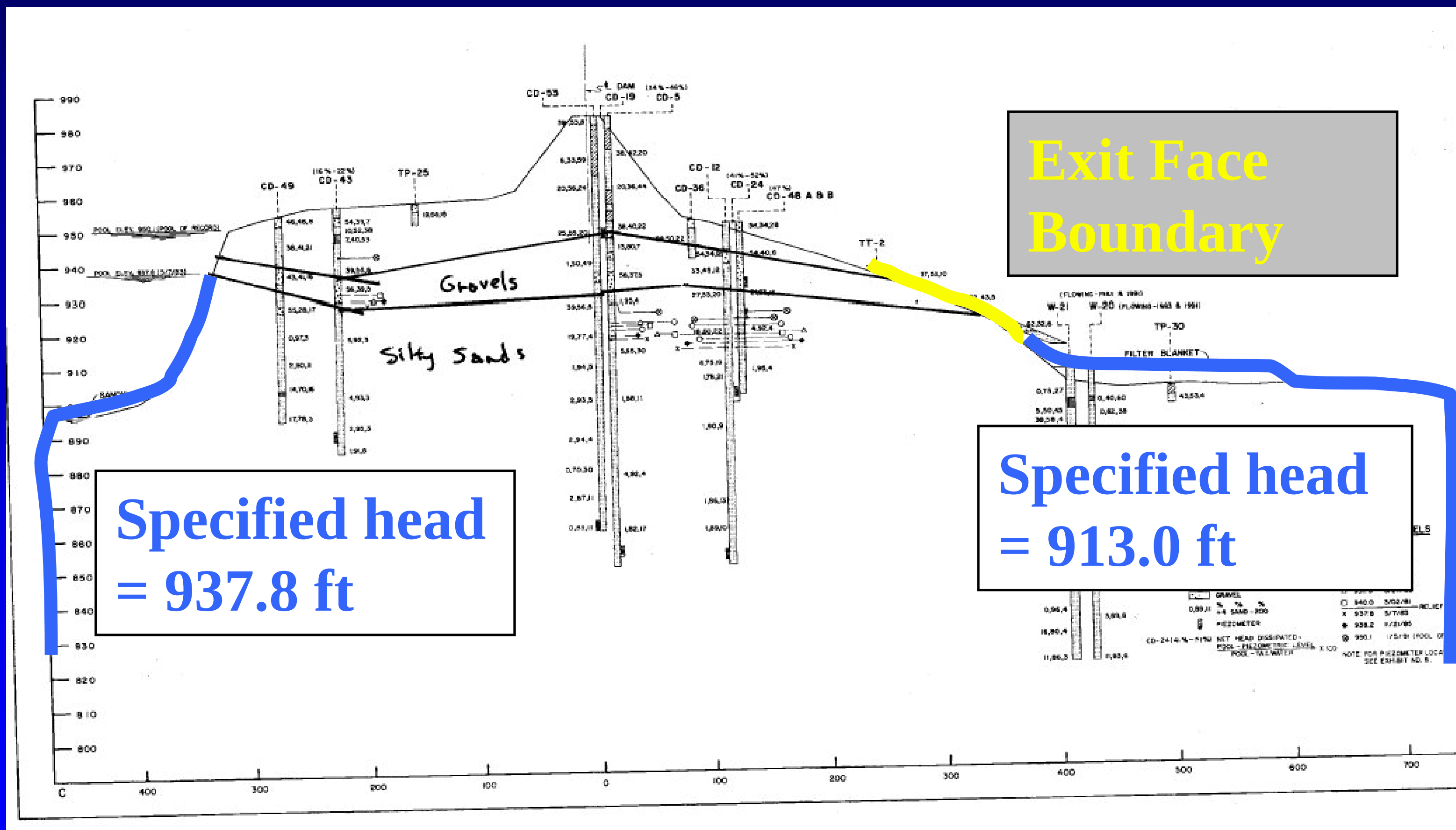
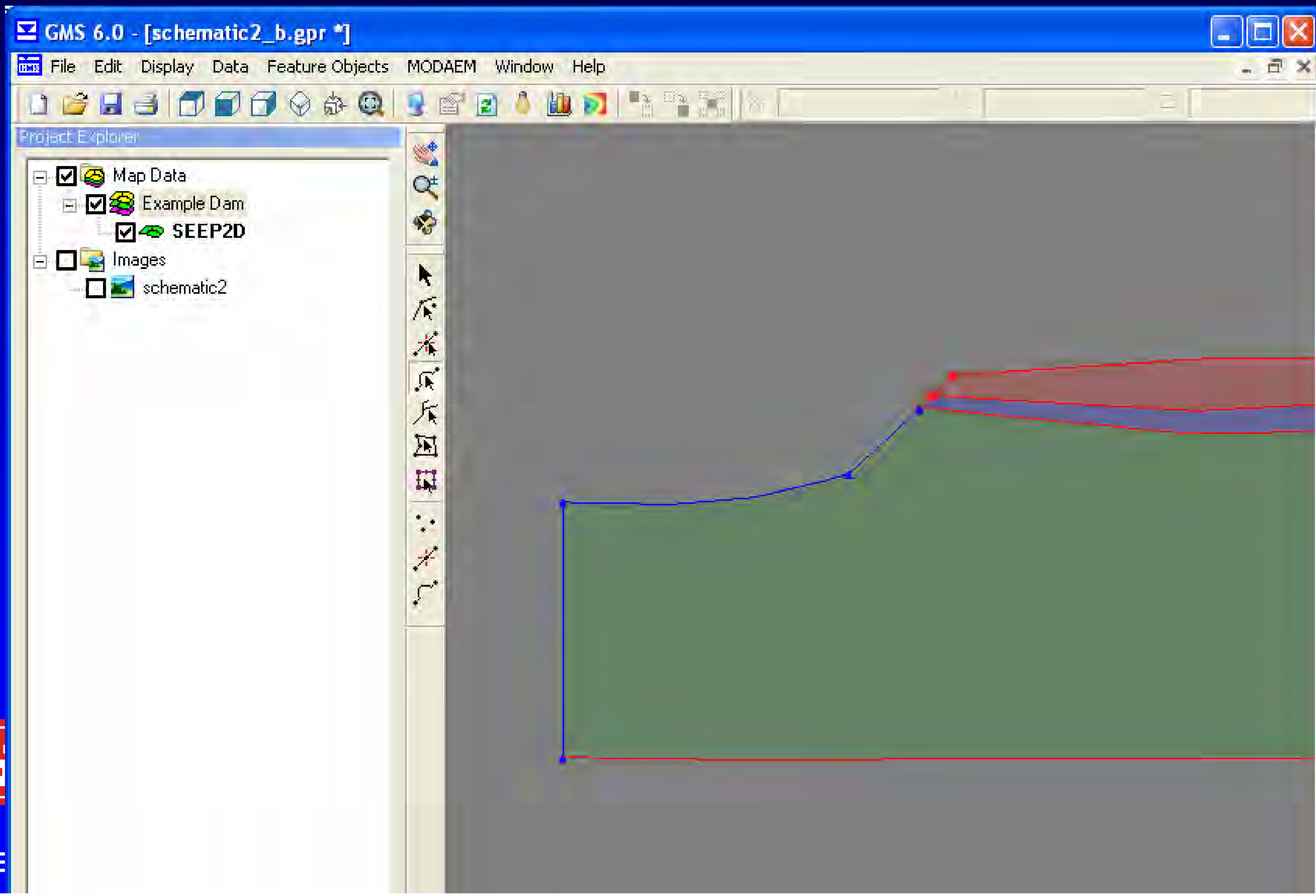
Assign Boundary Conditions



Assign Boundary Conditions



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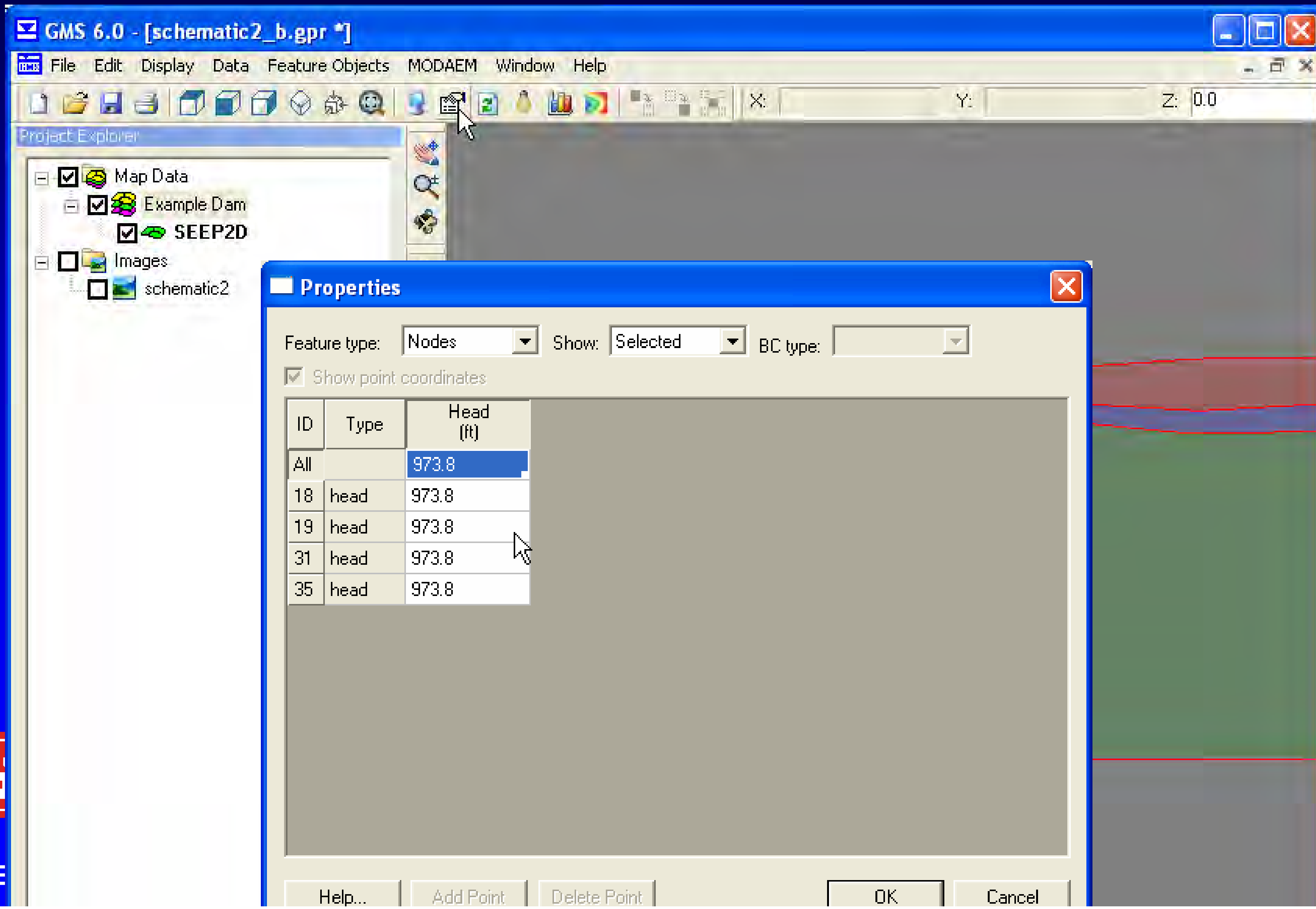
Assign Boundary Conditions



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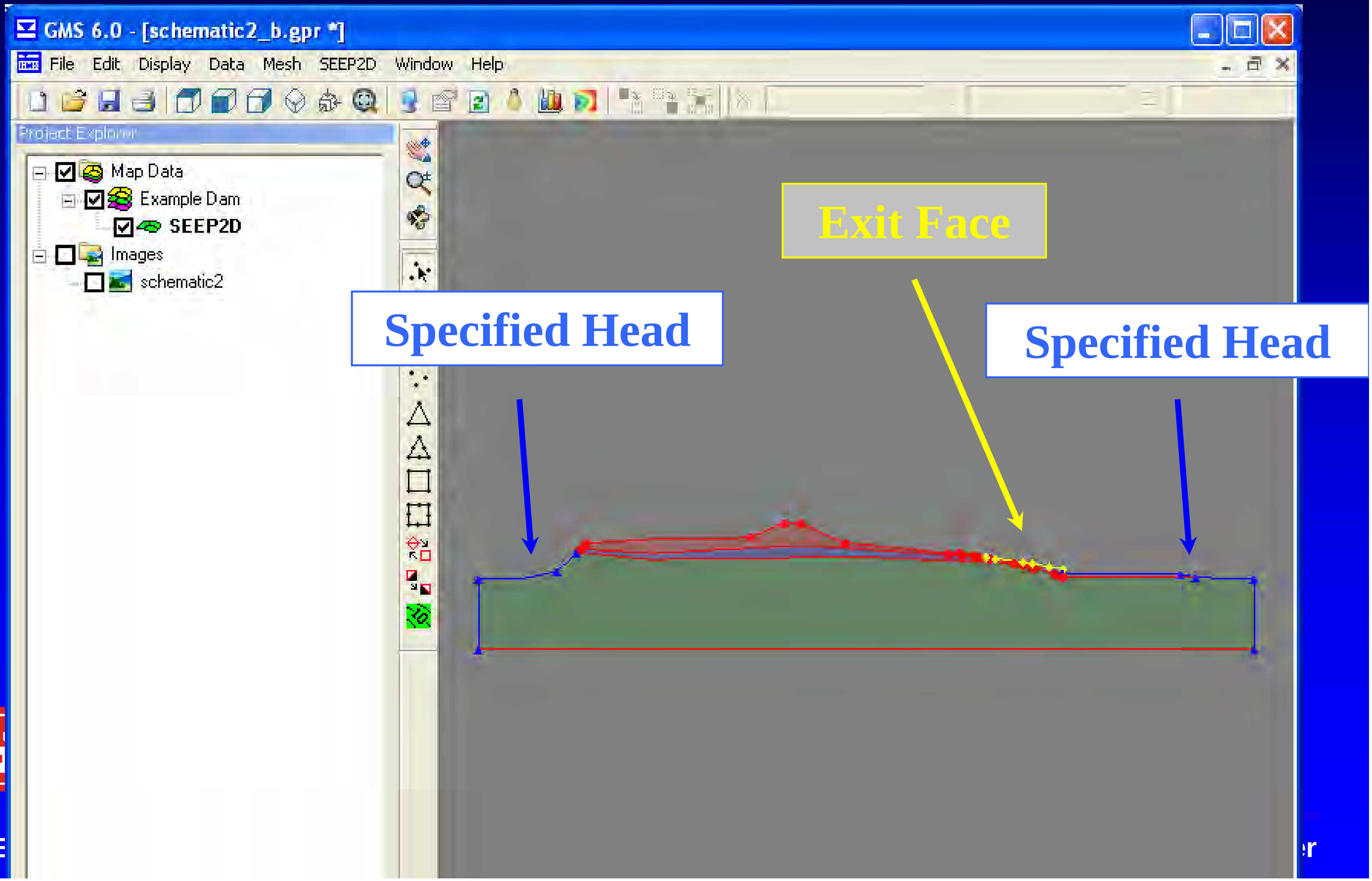
Assign Boundary Conditions



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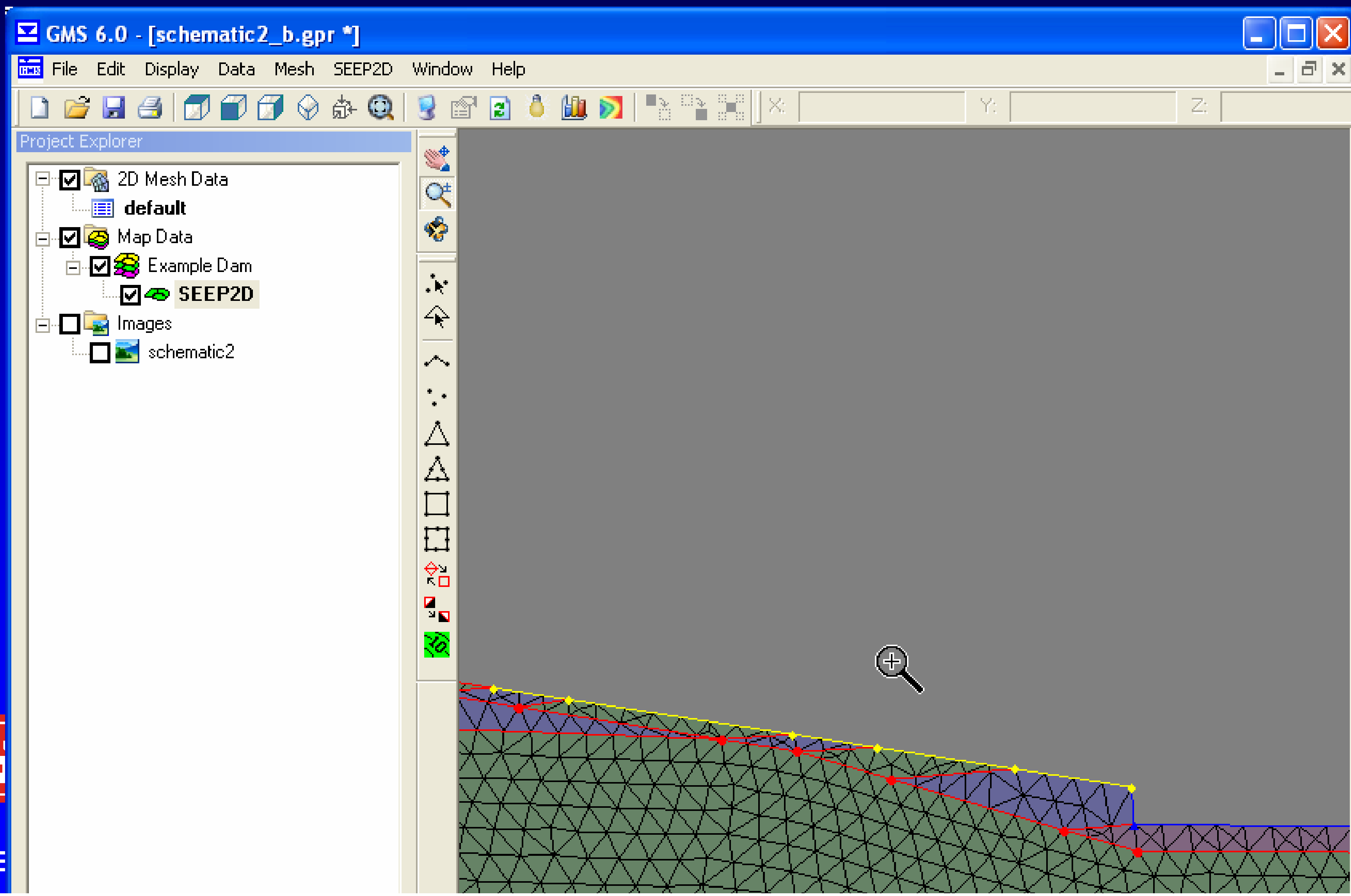
Build Computational Mesh



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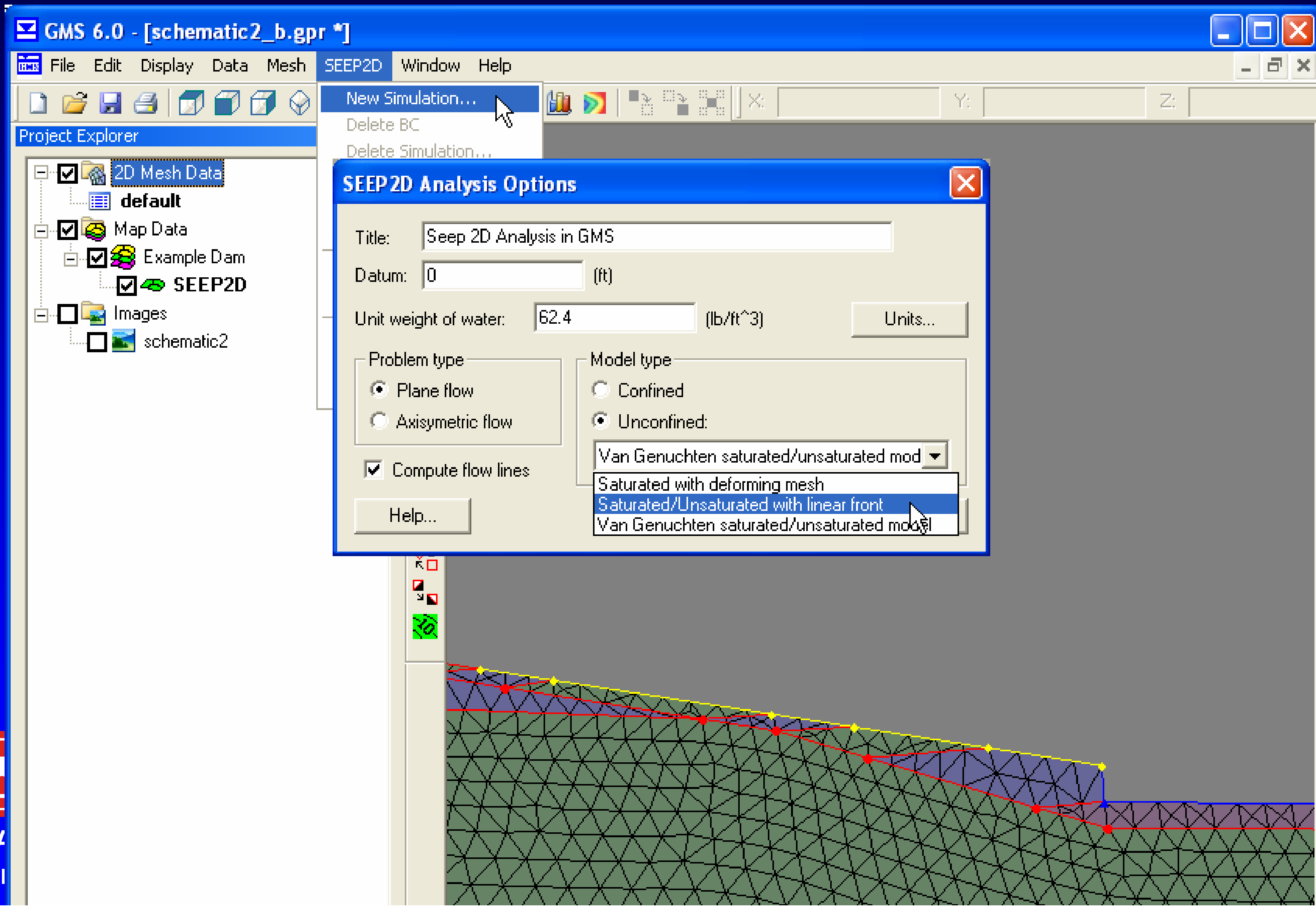
Initialize SEEP2D Simulation



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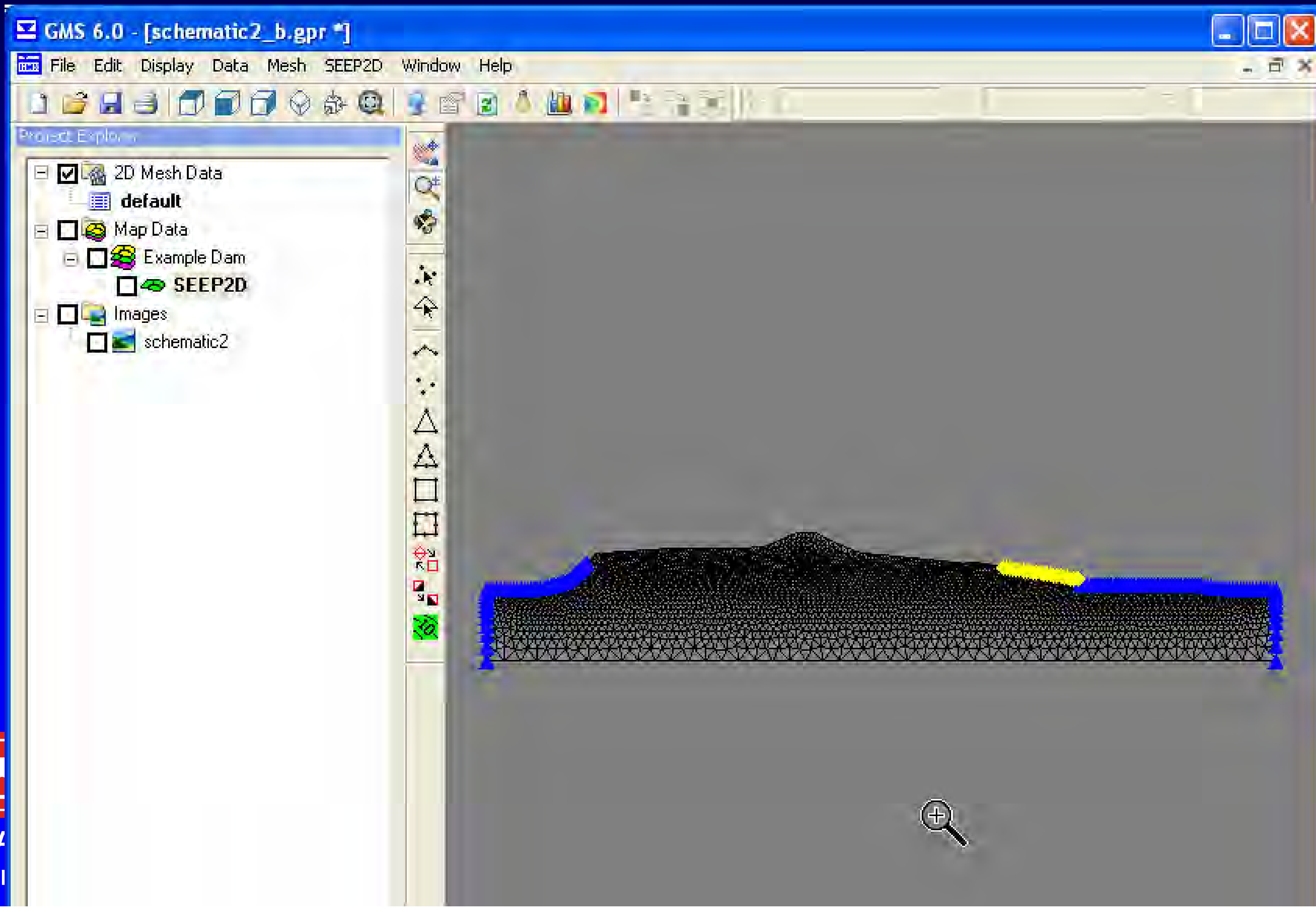
Map Boundary Conditions



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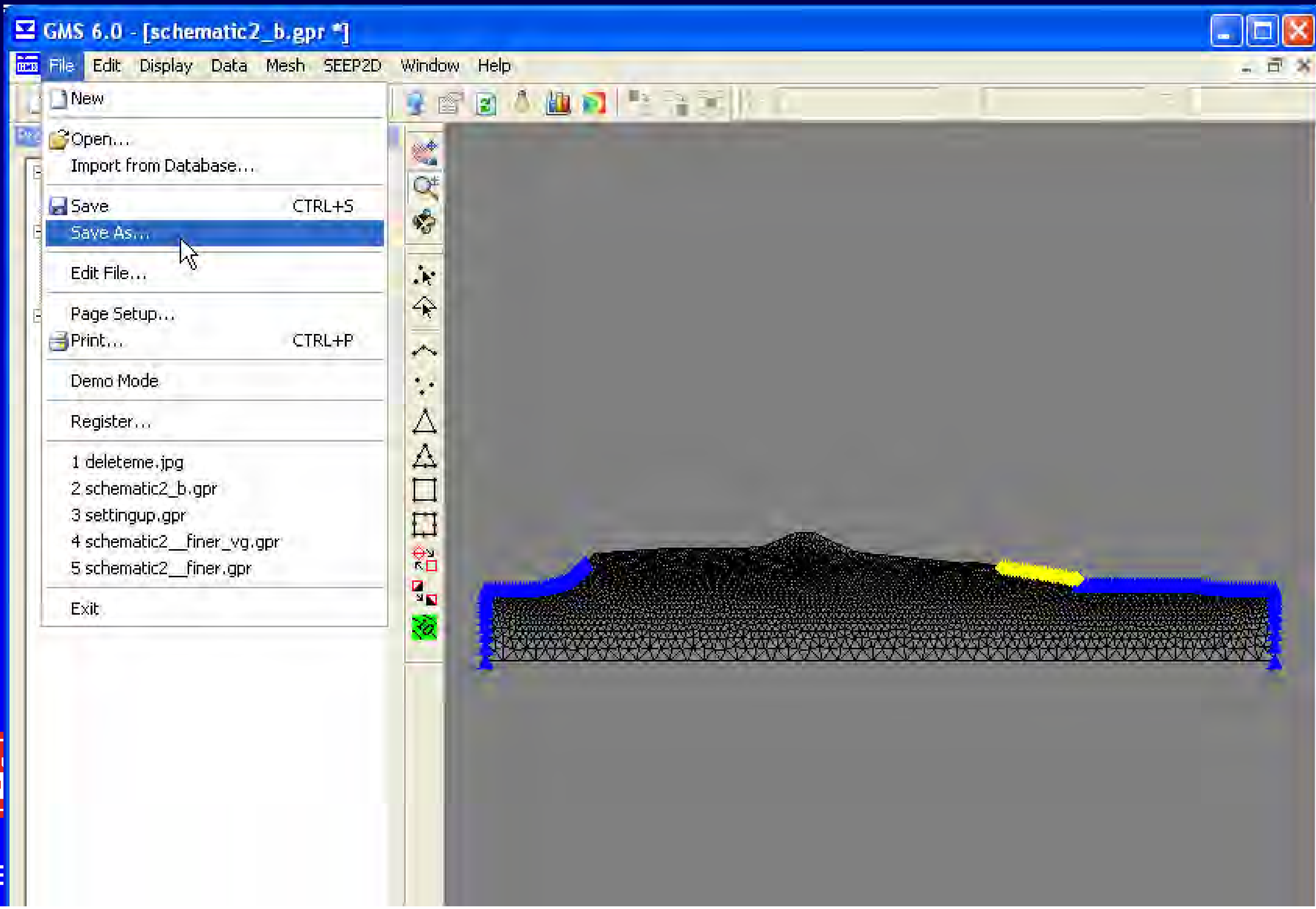
Save the Simulation



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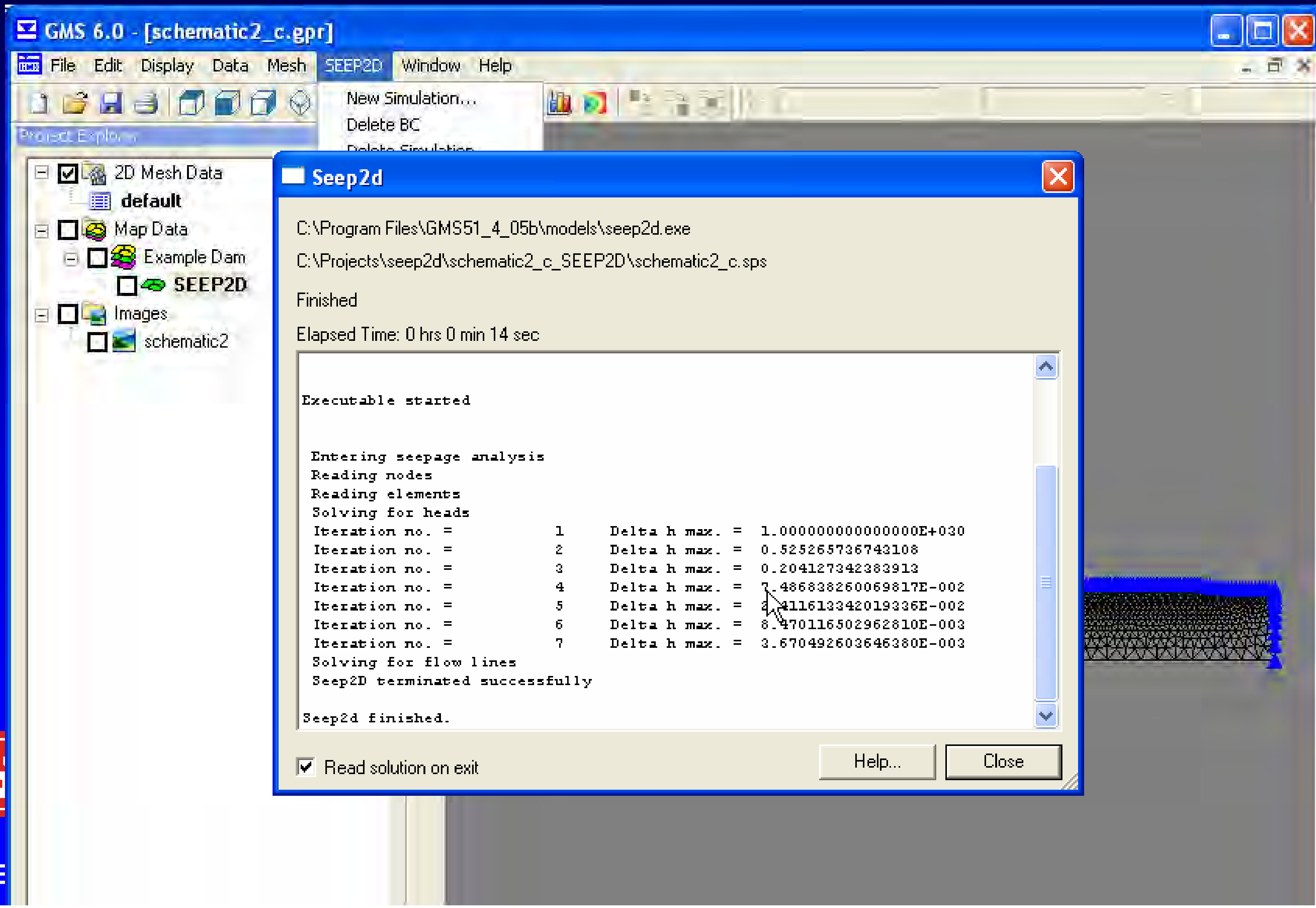
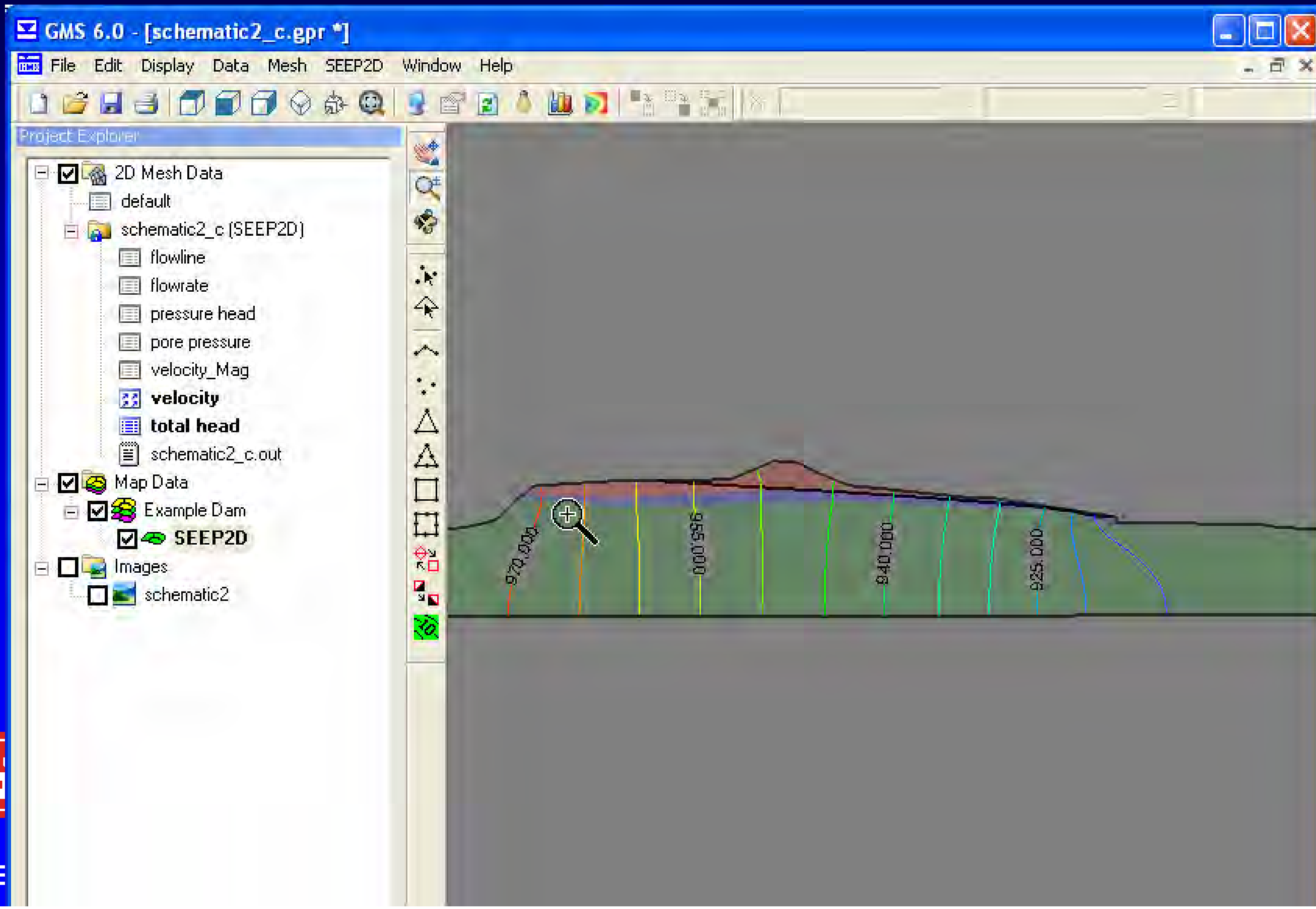
Run SEEP2D



GMS 6.0 - [schematic2_c.gpr]
File Edit Display Data Mesh SEEP2D Window Help
New Simulation...
Delete BC
2D Mesh Data
default
Map Data
Example Dam
SEEP2D
Images
schematic2
Seep2d
C:\Program Files\GMS51_4_05b\models\seep2d.exe
C:\Projects\seep2d\schematic2_c_SEEP2D\schematic2_c.sps
Finished
Elapsed Time: 0 hrs 0 min 14 sec
Executable started
Entering seepage analysis
Reading nodes
Reading elements
Solving for heads
Iteration no. = 1 Delta h max. = 1.000000000000000E+030
Iteration no. = 2 Delta h max. = 0.525265736743108
Iteration no. = 3 Delta h max. = 0.204127342383913
Iteration no. = 4 Delta h max. = 7.486838260069817E-002
Iteration no. = 5 Delta h max. = 2.411613342019336E-002
Iteration no. = 6 Delta h max. = 8.470116502962810E-003
Iteration no. = 7 Delta h max. = 3.670492603646380E-003
Solving for flow lines
Seep2D terminated successfully
Seep2d finished.
Read solution on exit
Help...
Close

View Results



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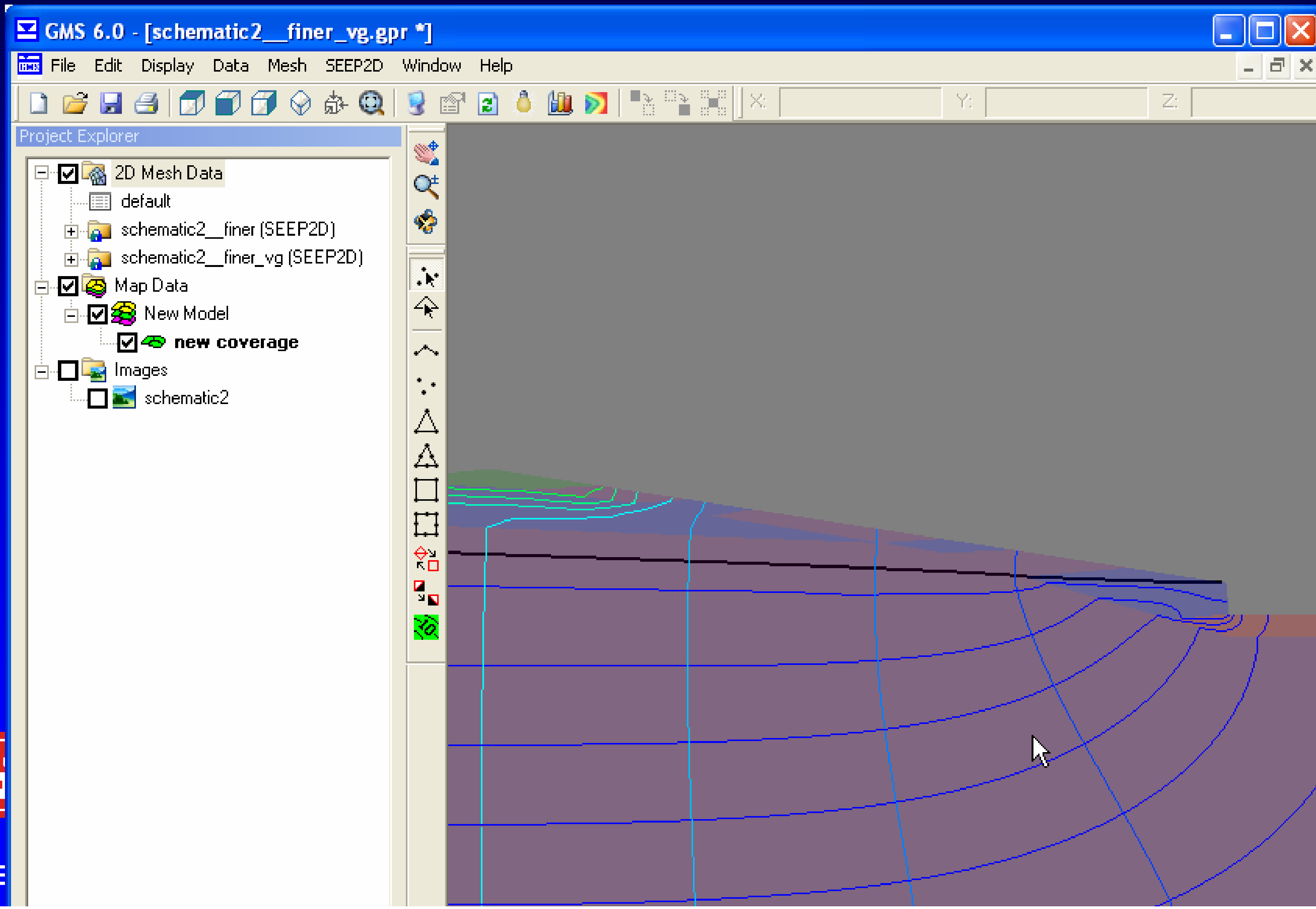
Conclusion

- SEEP2D is a fast, simple tool for seepage analysis.
- GMS provides a nice interface for setting up the problem and assigning boundary conditions.
- GMS also provides multiple options for viewing and analyzing the results.
- Best of all… SEEP2D and GMS are free for federal employees (DoD, DoE, EPA, NRC)

Issues to Consider:

- Mesh resolution
- How to handle the unsaturated zone:
  - Linear Front
  - Van Genuchten parameters

Mesh Resolution



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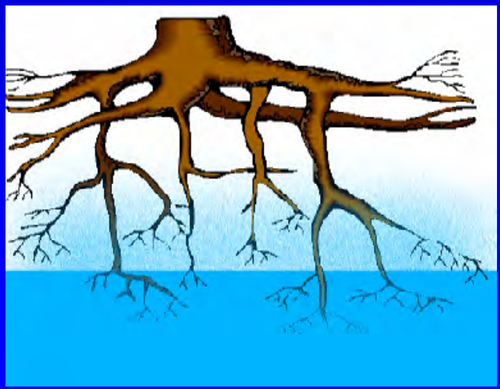
Unsaturated Zone Flow

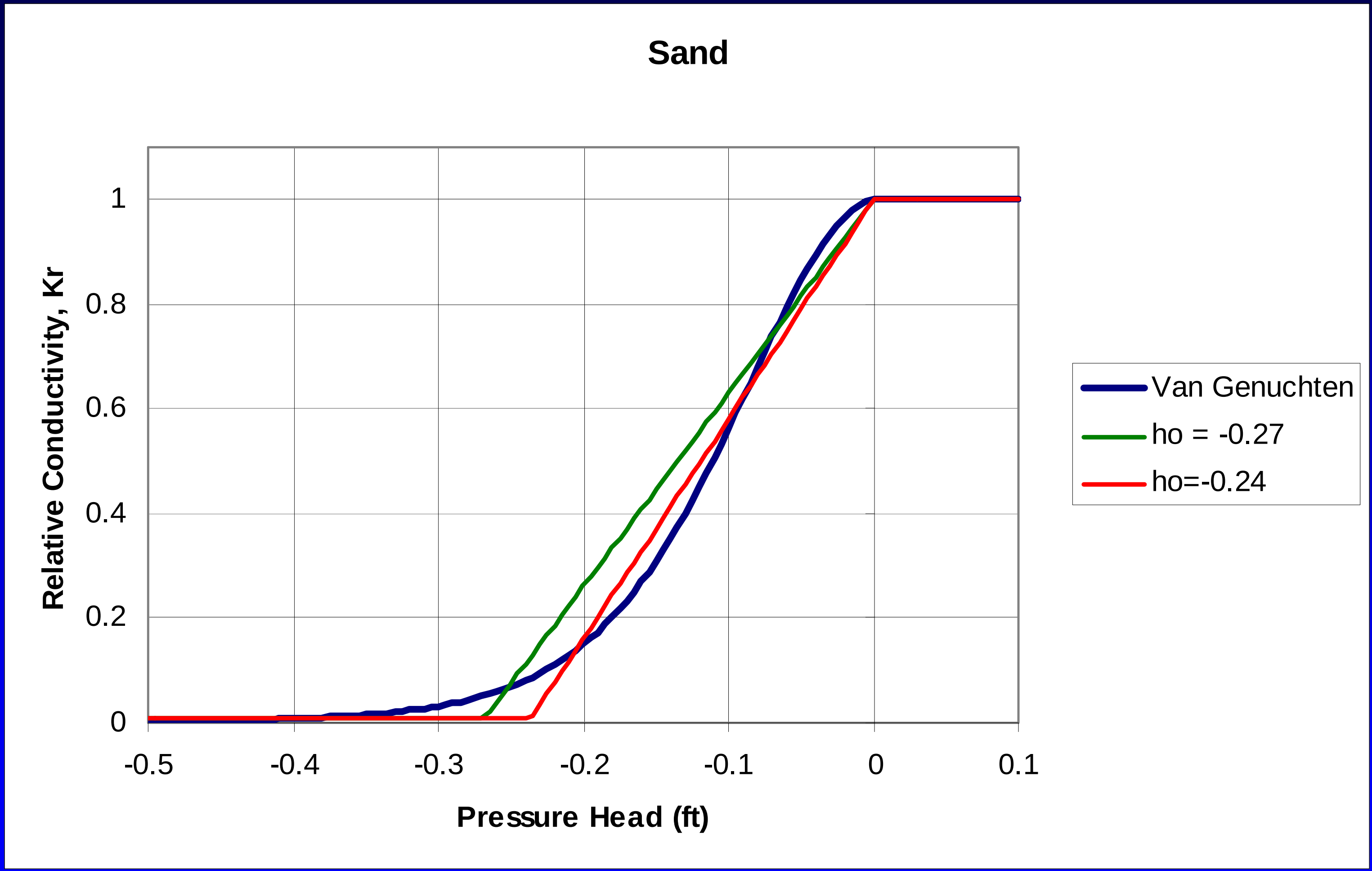
- Conductivities are lower than the saturated value and can be tied to the pressure head.
- SEEP2D calculates K_r, relative conductivity, and uses the following equation to determine the conductivity at each node having a negative pressure head:
  - $K = K_{sat} * K_r$



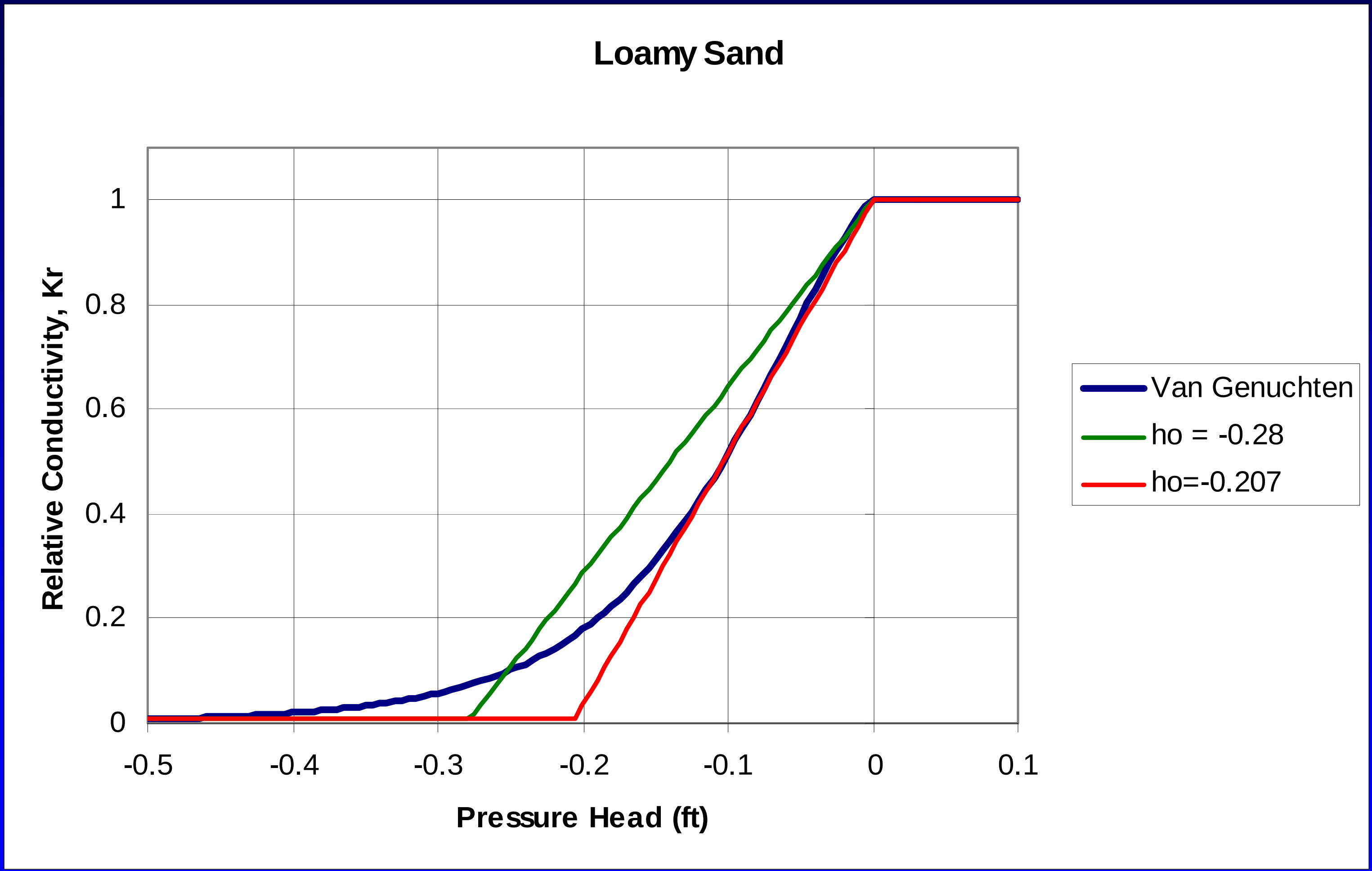
Unsaturated Zone Flow

- Two ways to determine K_r:
  - Van Genuchten Parameters
    - User supplies α, n.
    - Estimated for several soil types in:
      - Carsel, F. F. and R. S. Parrish. 1988. Developing joint probability distributions of soil water retention characteristics. *Water Resources Research* 24, no. 5:755-69.
  - Linear Approximation
    - User supplies h_o, K_{ro}

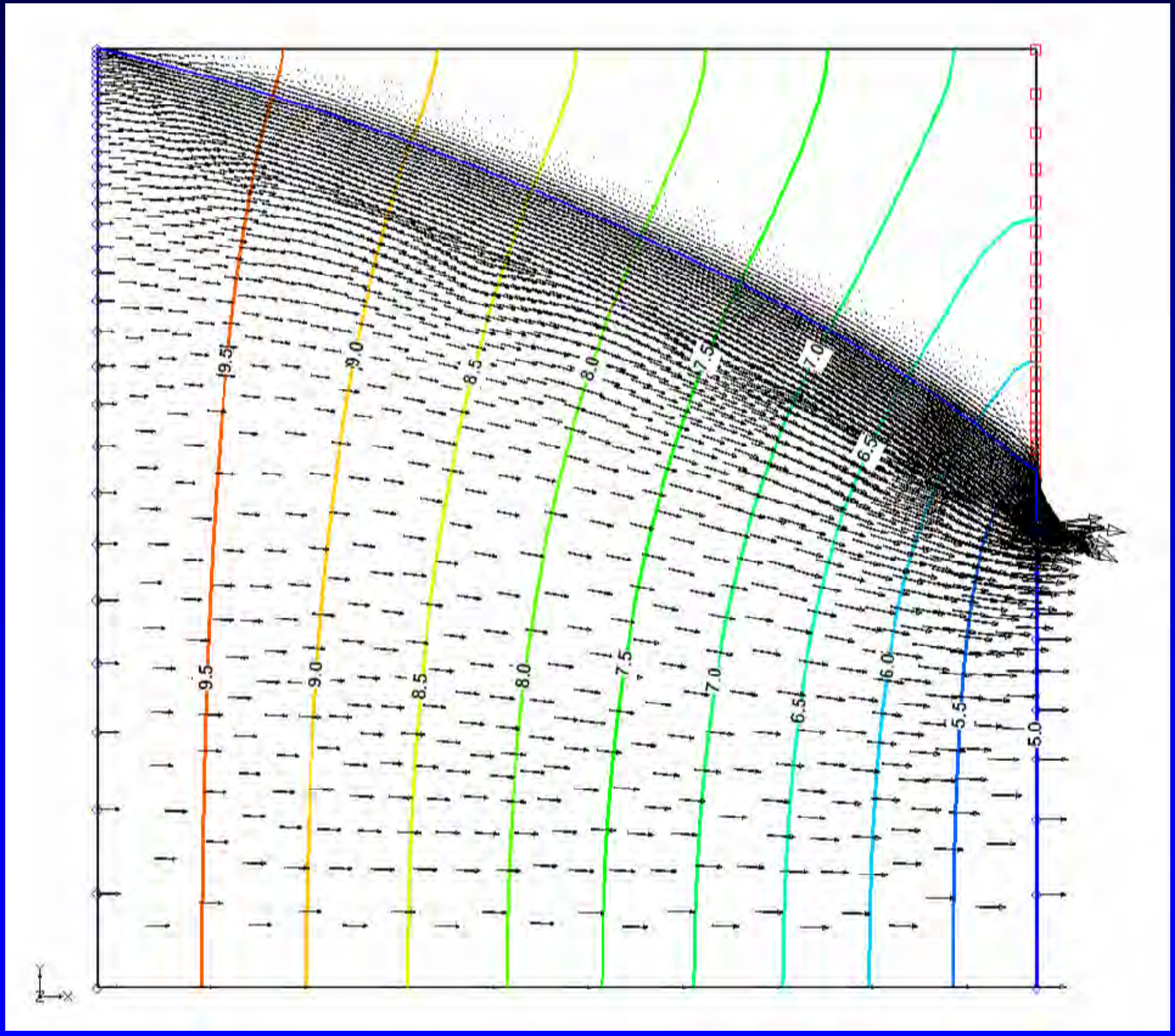
Unsaturated Zone Flow



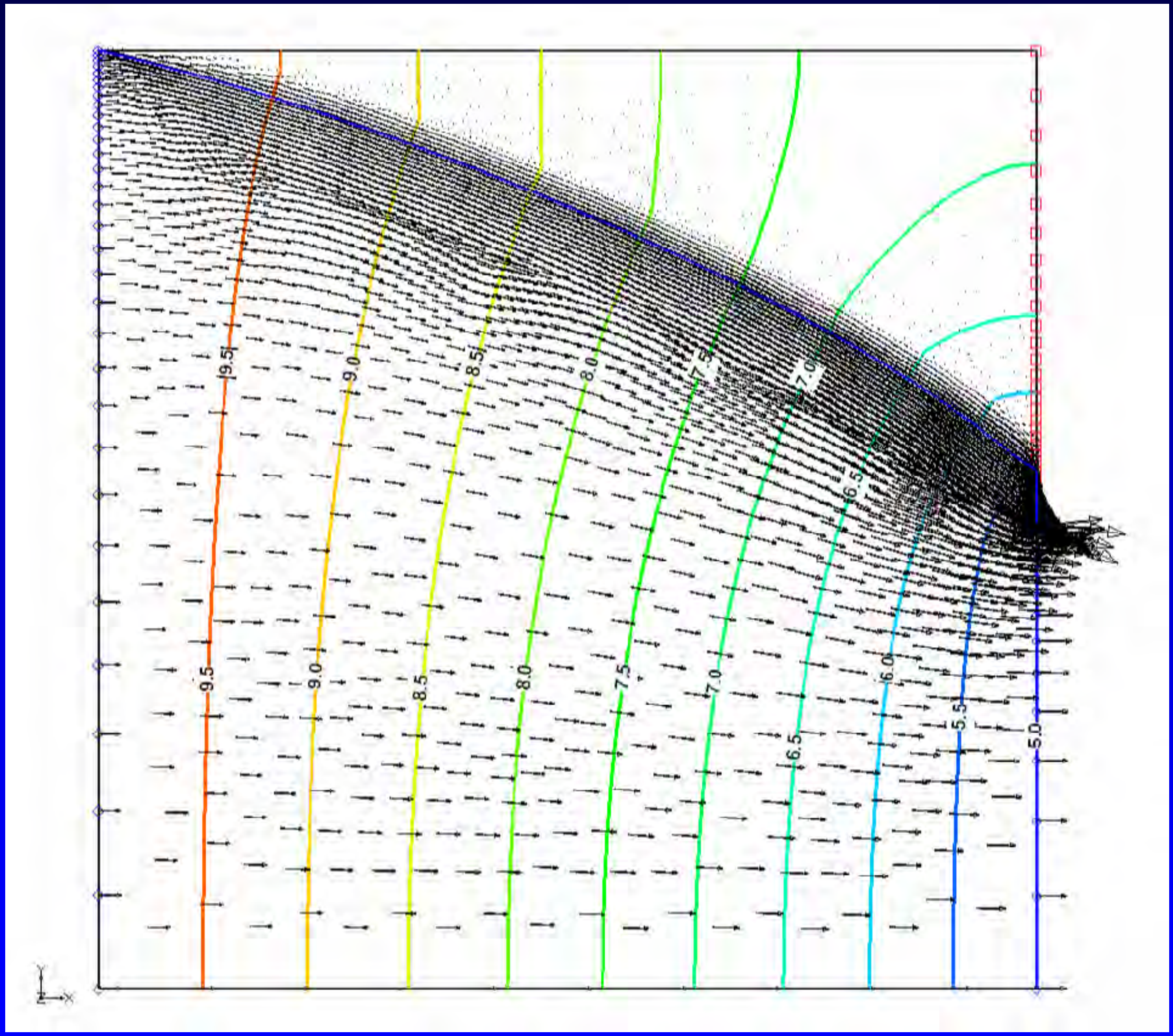
Unsaturated Zone Flow



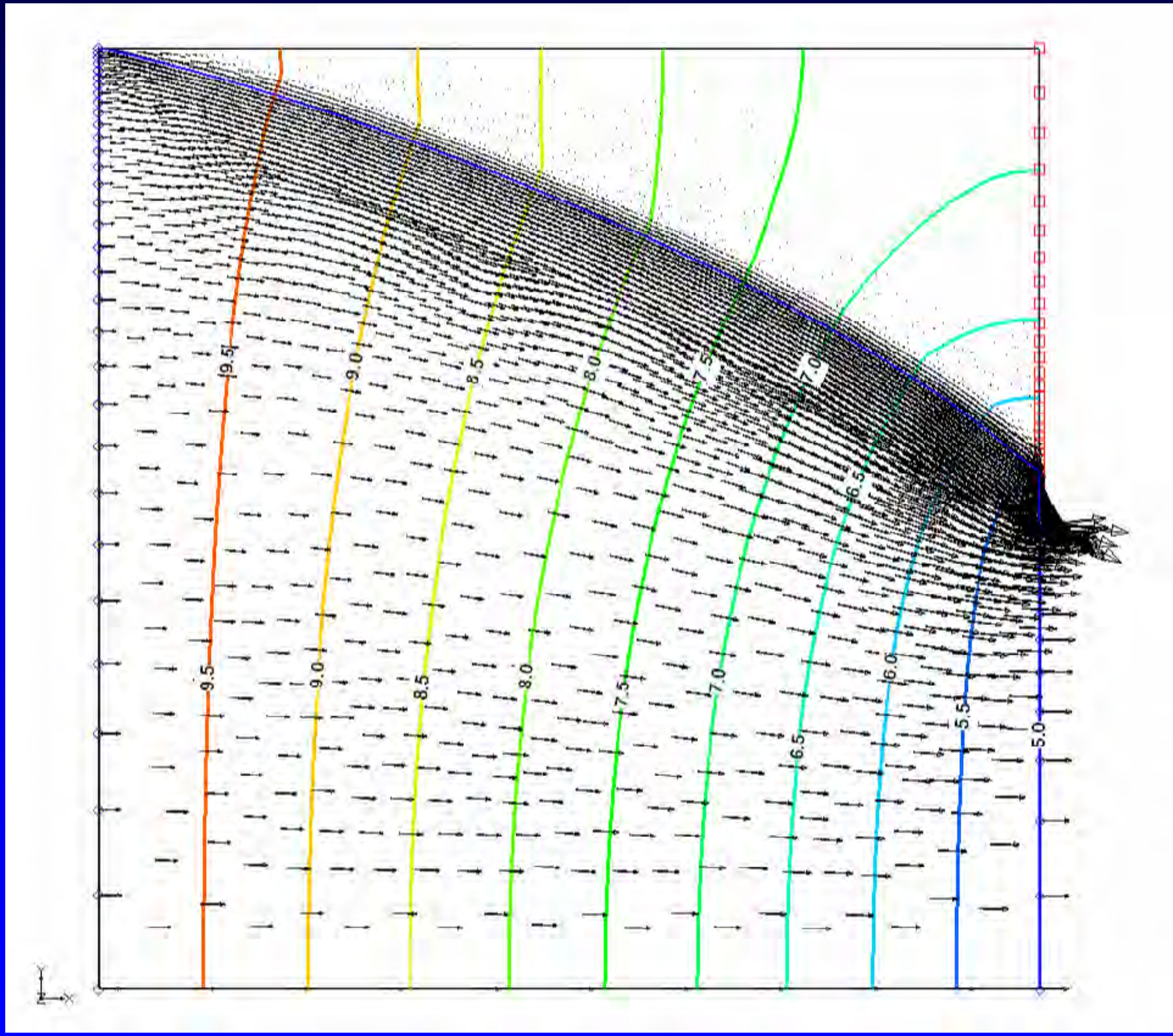
Loamy Sand – Van Genuchten



Loamy Sand – Linear, h_o=-0.28



Loamy Sand – Linear, h_o=-0.207



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Contact Information

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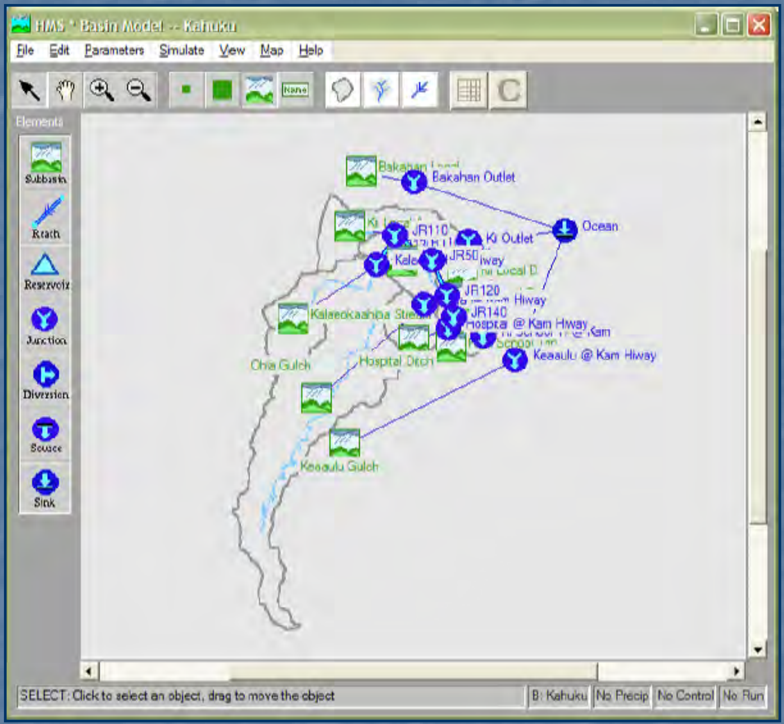
- (601)634-2102
- Coastal & Hydraulics Laboratory, ERDC, USACE
- Clarissa.M.Hansen@erdc.usace.army.mil

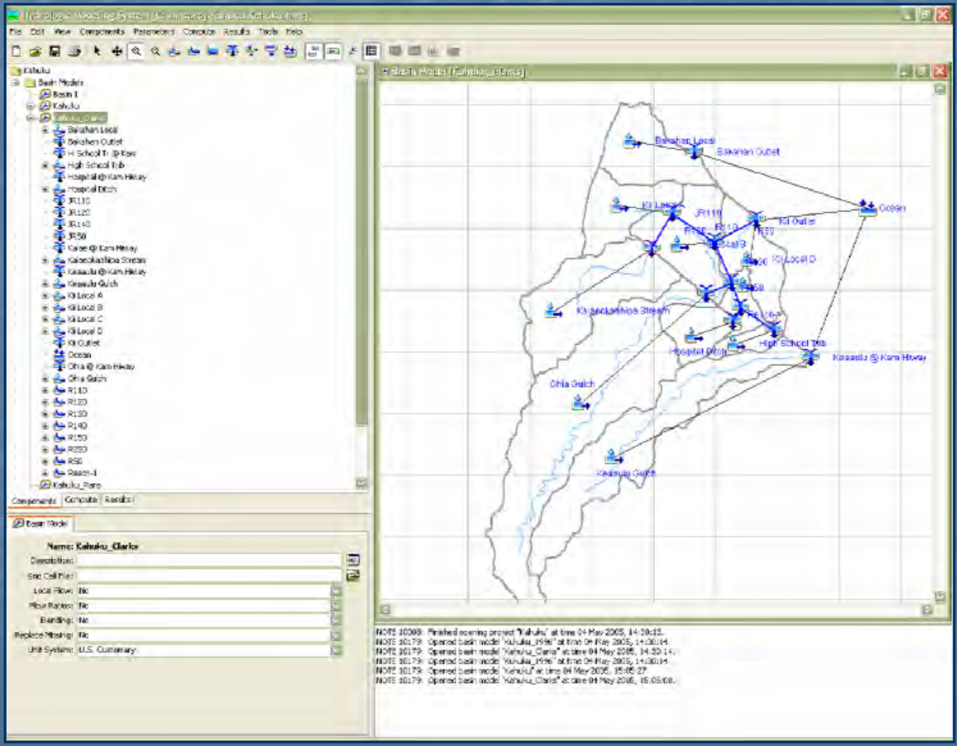
Hydrologic Engineering Center

HEC–HMS

Version 3.0

New Features





US Army Corps of Engineers
Hydrologic Engineering Center

2005 Tri-Services Infrastructure Conference, St. Louis

Topics

- HEC-HMS
  - Version 3.0
  - Concepts
  - Data Components
  - Simulation
  - Results

HEC-HMS Version 3.0

- Initial Release
  - New User Interface - JAVA
  - Snow Accumulation and Melt
  - Depth-Area Storm Event Analysis
  - Evapotranspiration
- Under Development
  - Interior Flooding Capabilities
  - Land Surface Wash-off

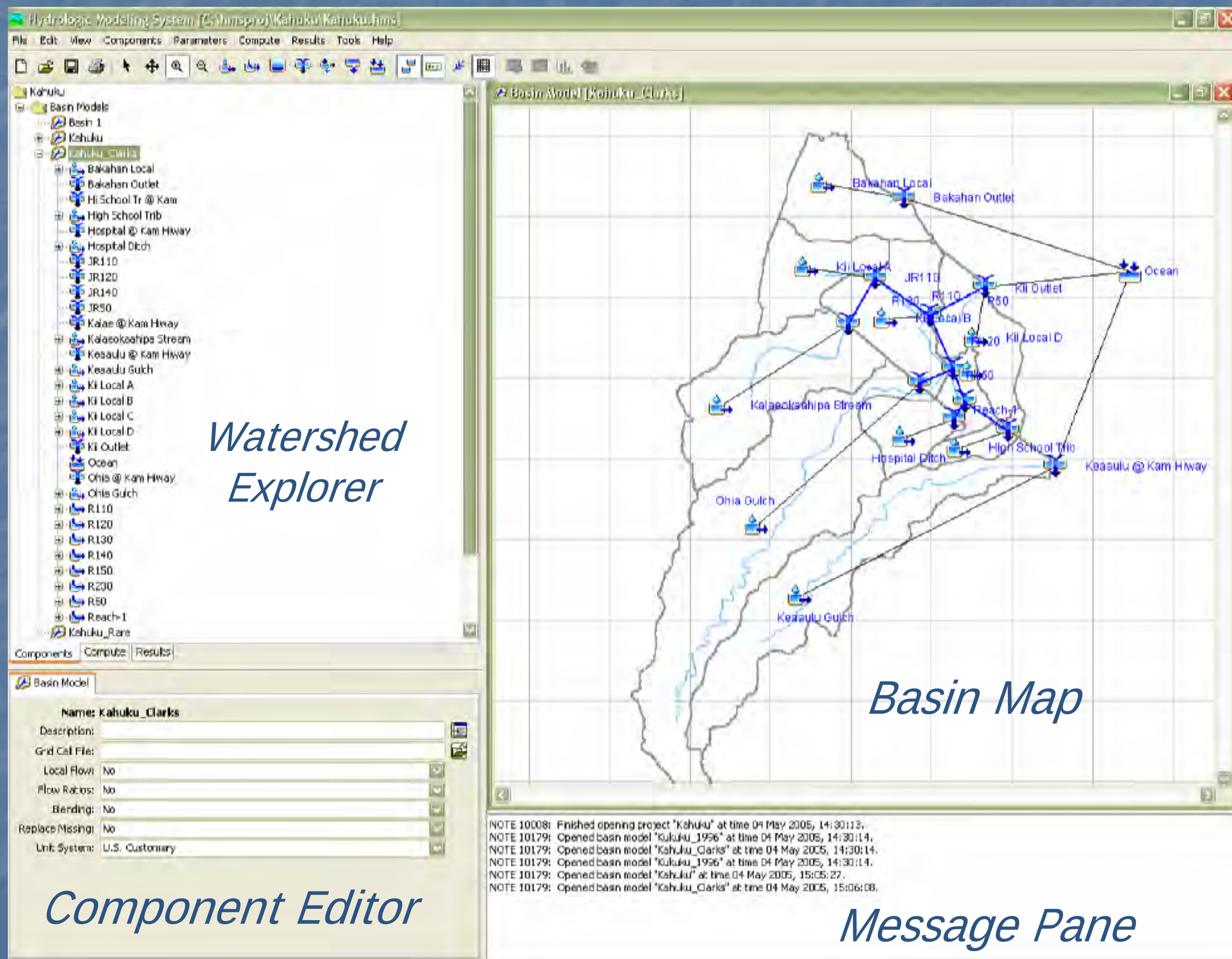
New User Interface - JAVA

- Finished Java Conversion
  - Converted Entire Existing Engine with Data Model and Simulation Components from C++, Galaxy to Java
  - Scraped Old Interface in Favor of New Design
    - Easy to Learn
    - More Flexible for Configuring Data and Viewing Results
    - Faster to Use Because it Anticipates User Needs
    - Similar in Layout to Other Engineering Software
  - New Interface Design Complete
- Beta Testing in Progress
  - Approximately 60 testers
  - Several International
  - Testing Complete August 26th

HMS Provides

- Tool kit of options
  - Basin Parameters
  - Parameter estimation (optimization)
- Graphical user interface
  - Select-and-add icons
  - Graphical and tabular displays
- Multiple operating system support
  - Windows, UNIX

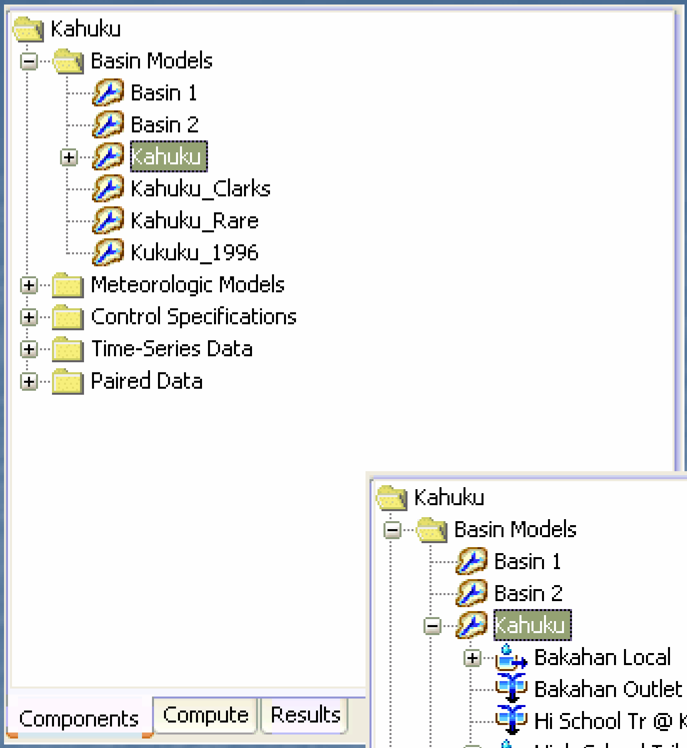
HMS Version 3.0

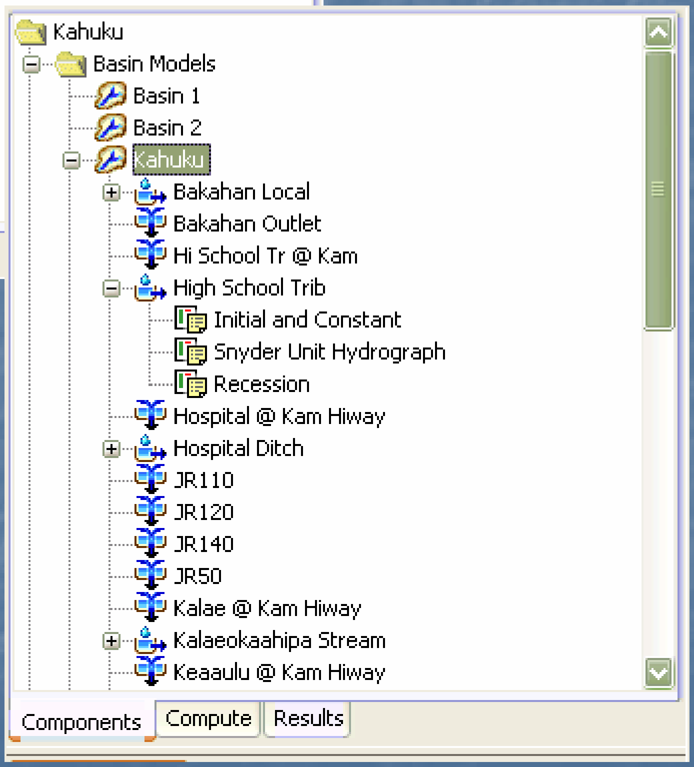


HEC

Watershed Explorer

- List All Project Components
- Expand Multiple Components
- List All Elements
- Icon Shows Element Type
- Direct Access to Methods
- Selected Element Highlighted on Map
- Right Click Menu





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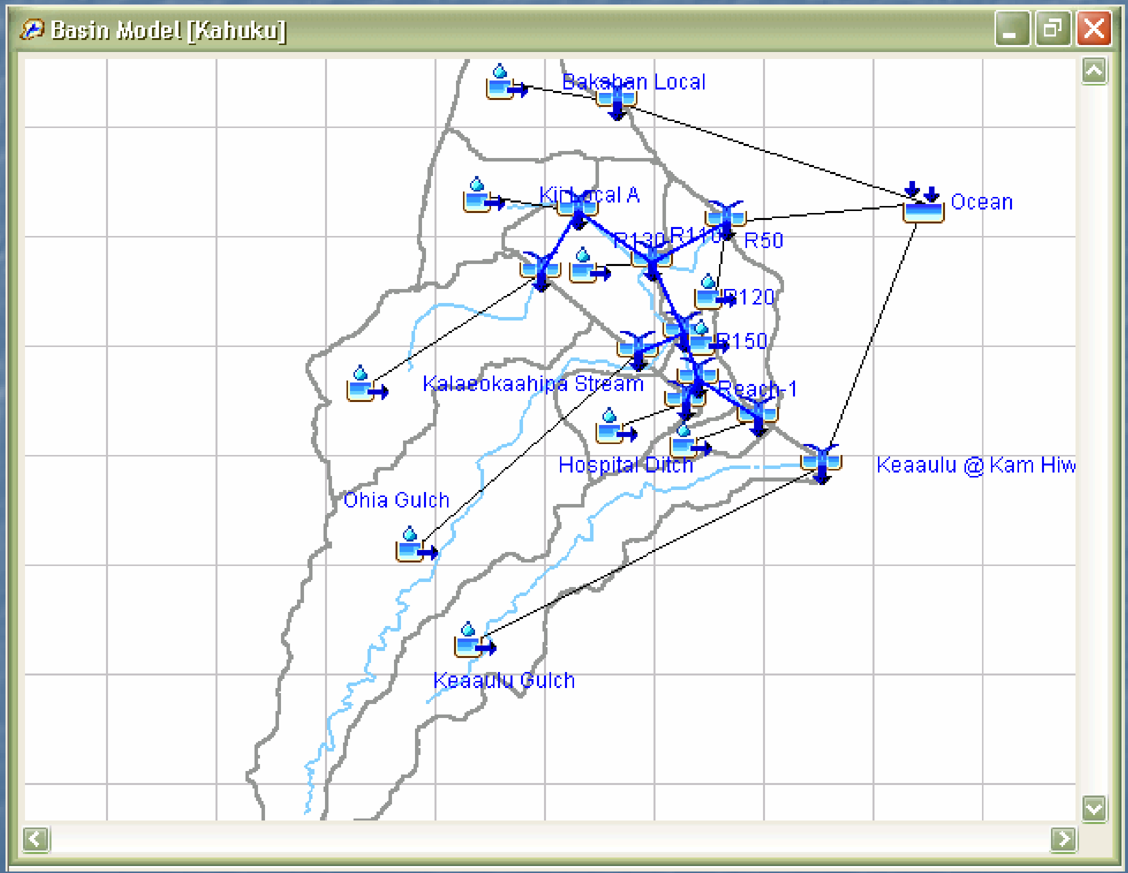
Basin Map

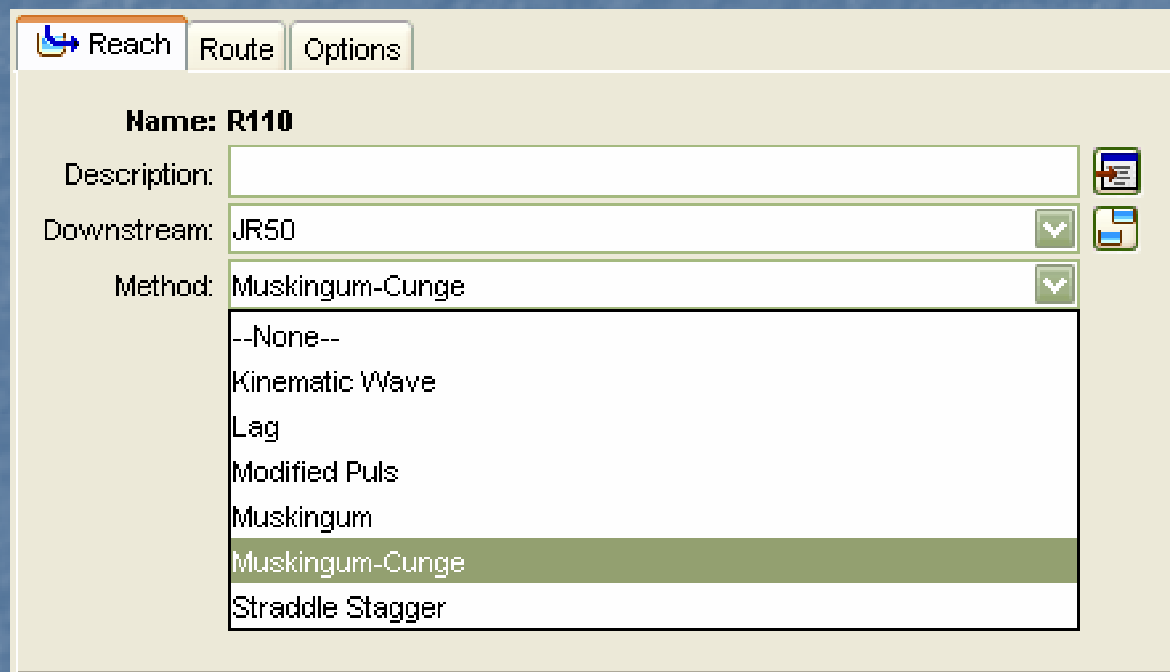
- Georeferenced
- Shows all elements
- Make any Element Active
- Zoom In and Out
- Right Click Menu
- View Results



HEC

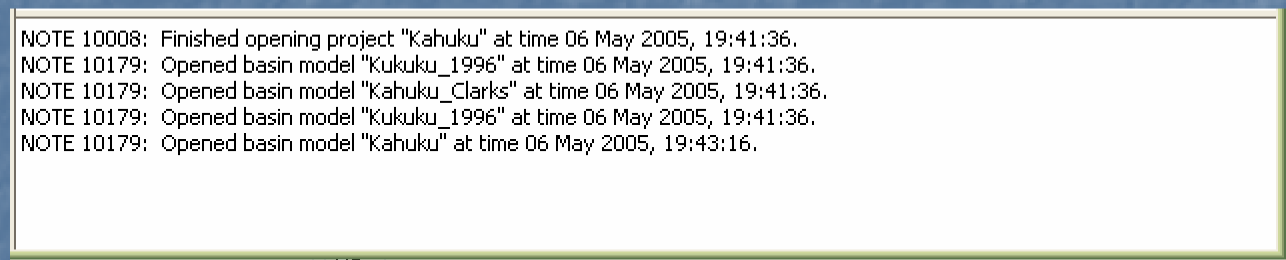
Component Editor

- Editors for all Elements
- Automatically Reflects Selected Element



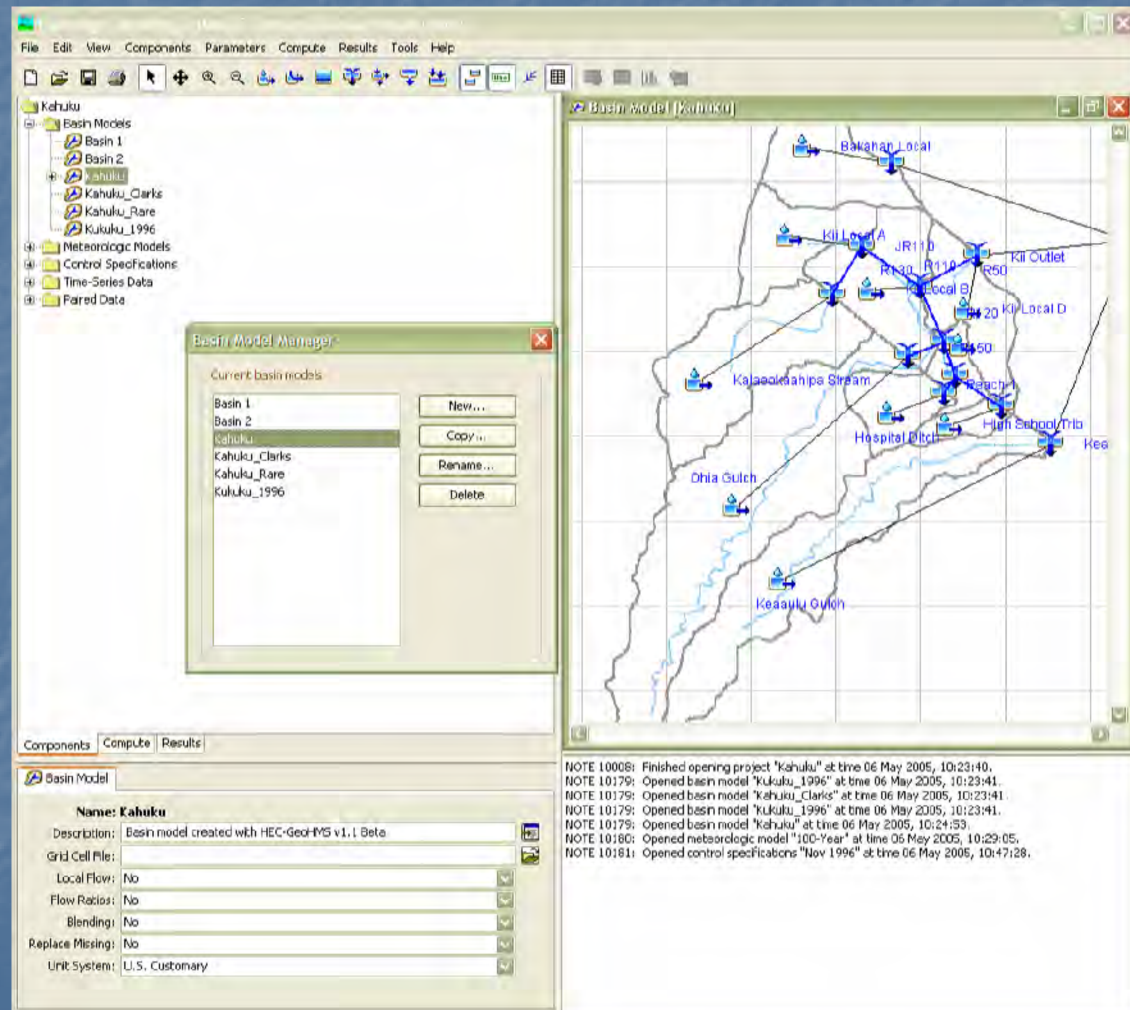
Message Pane

- Instant Feedback
- Lists errors
- Tracks Current Execution



HEC-HMS Project

- Container for components
  - Basin model
  - Gage and paired data
  - Gridded data
  - Meteorologic model
  - Control specifications
- Analysis methods
  - Simulation
  - Parameter estimation (optimization)
  - Depth-Area



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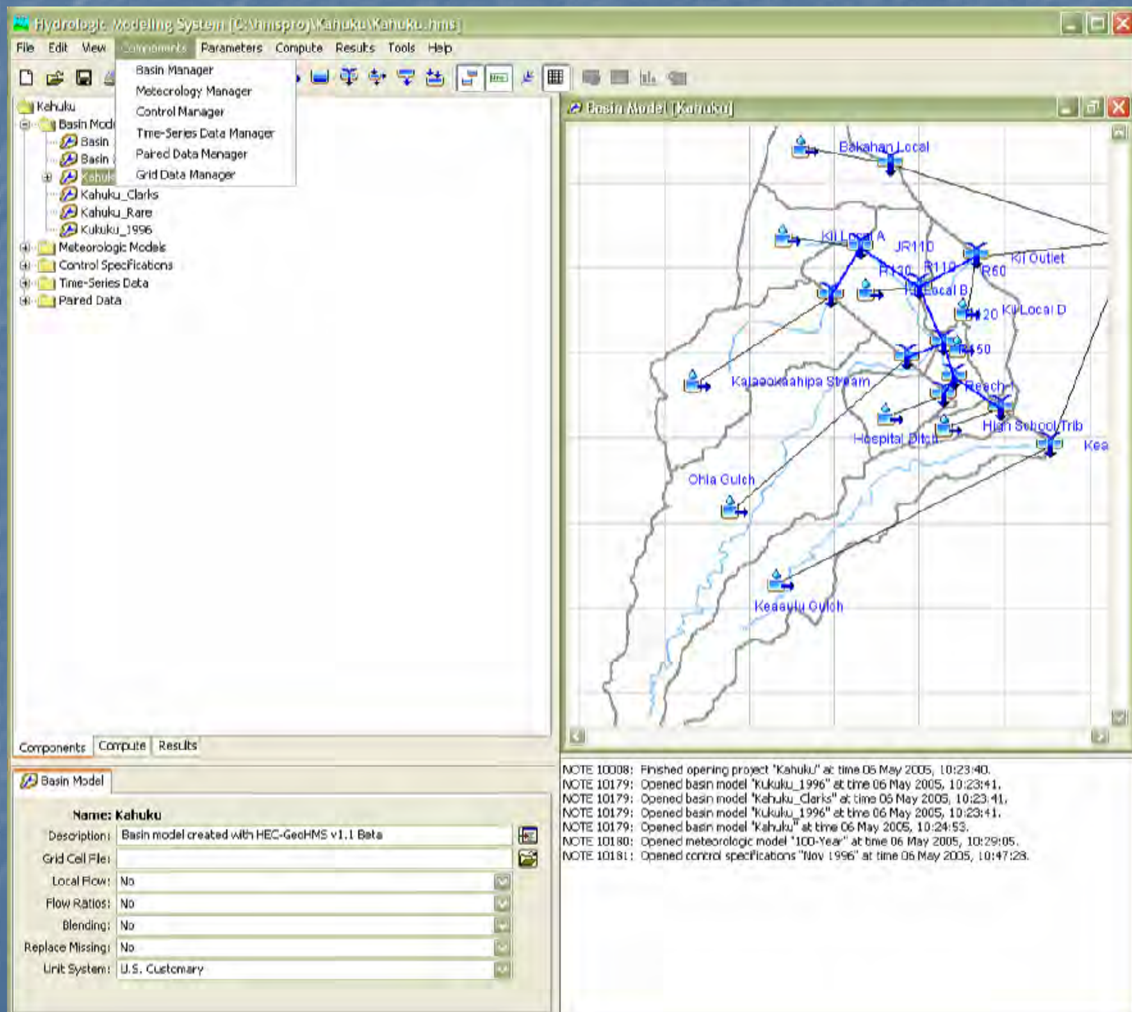
HEC-HMS Project Components



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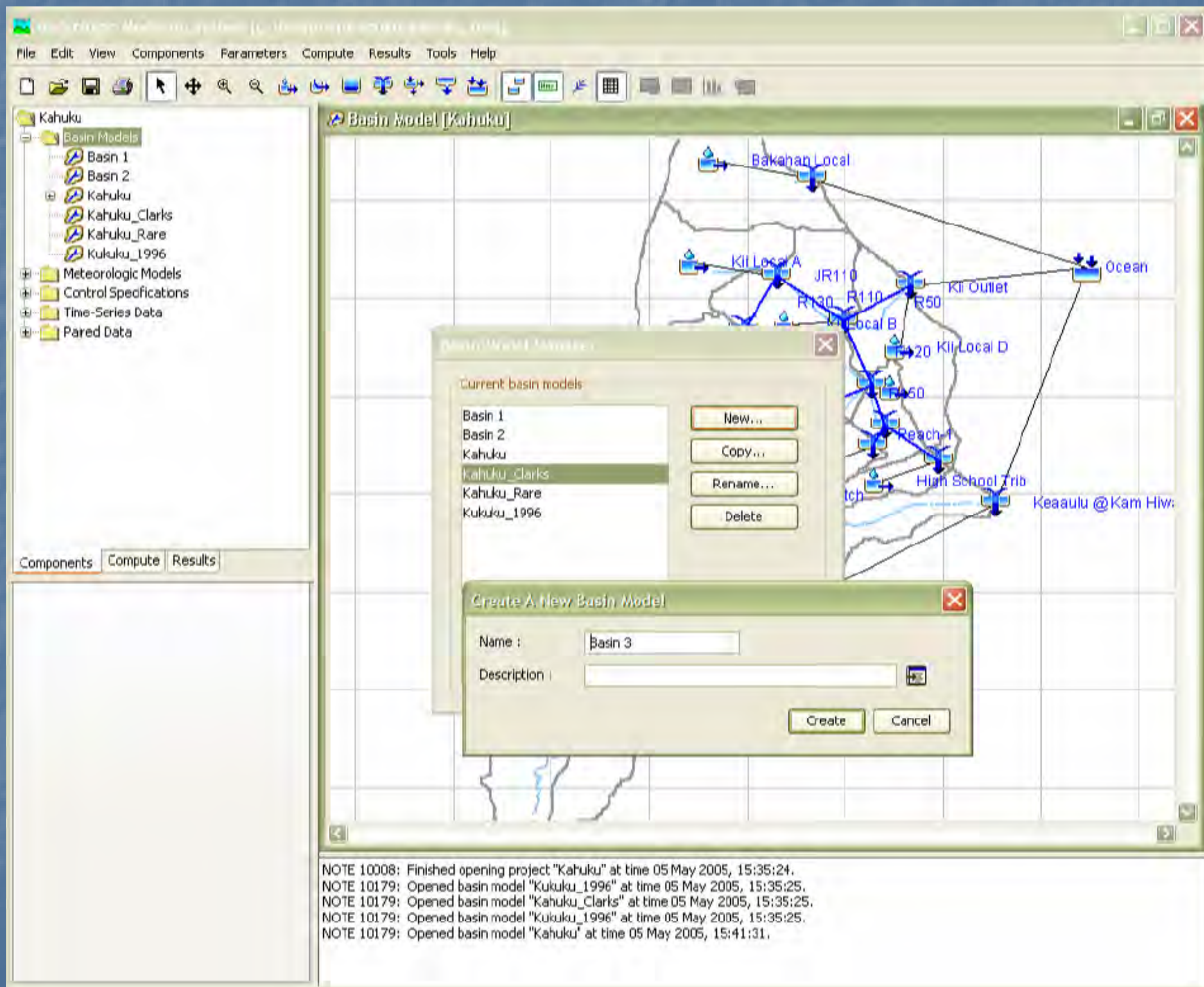
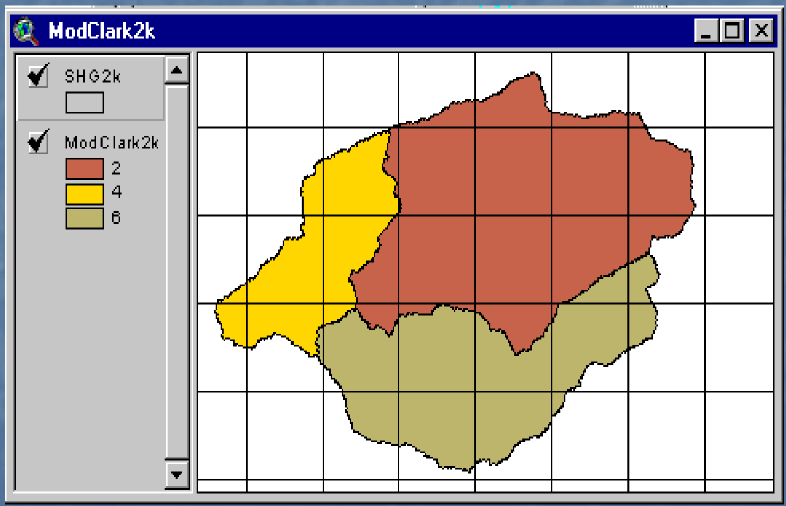
Basin Models



HEC

Basin Model Types

- Area Averaged
  - Parameters apply to entire subbasin
- Gridded (GeoHMS)
  - ModClark Transform
  - Gridded Precip
    - HRAP, SHG
  - Grid Cell File

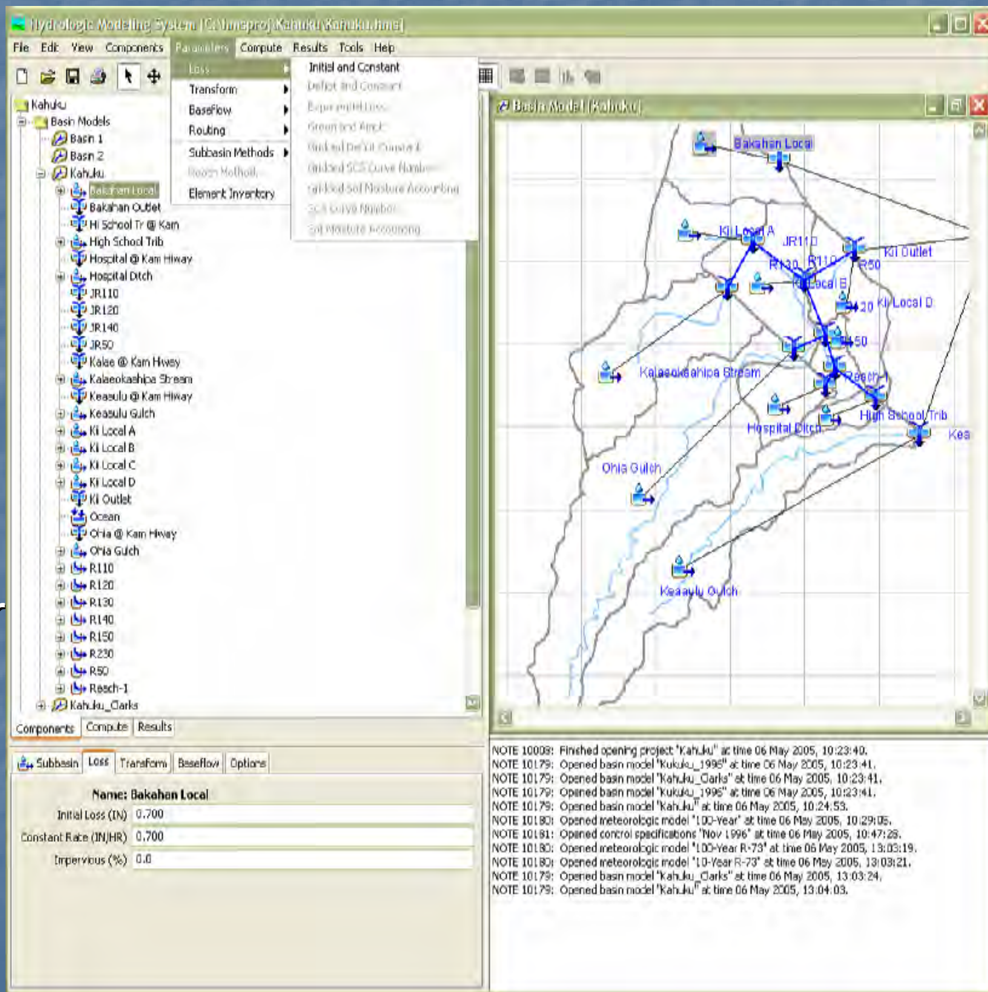


Basin Model Elements

- Subbasin - *Watershed Catchments*
- Reach - *Rivers and Streams*
- Reservoir - *Dams and Lakes*
- Junction - *Confluence*
- Diversion - *Bifurcations and Withdrawals*
- Source - *Springs and other Model Sinks*
- Sink - *Outlets and Terminal Lakes*

Subbasin Element Loss Parameter

- Loss Methods
  - Initial and Constant
  - Deficit and Constant
  - Evapotranspiration
  - Green and Ampt
  - Gridded Deficit Constant
  - Gridded SCS Curve Number
  - Gridded SMA
  - SCS Curve Number
  - Soil Moisture Accounting



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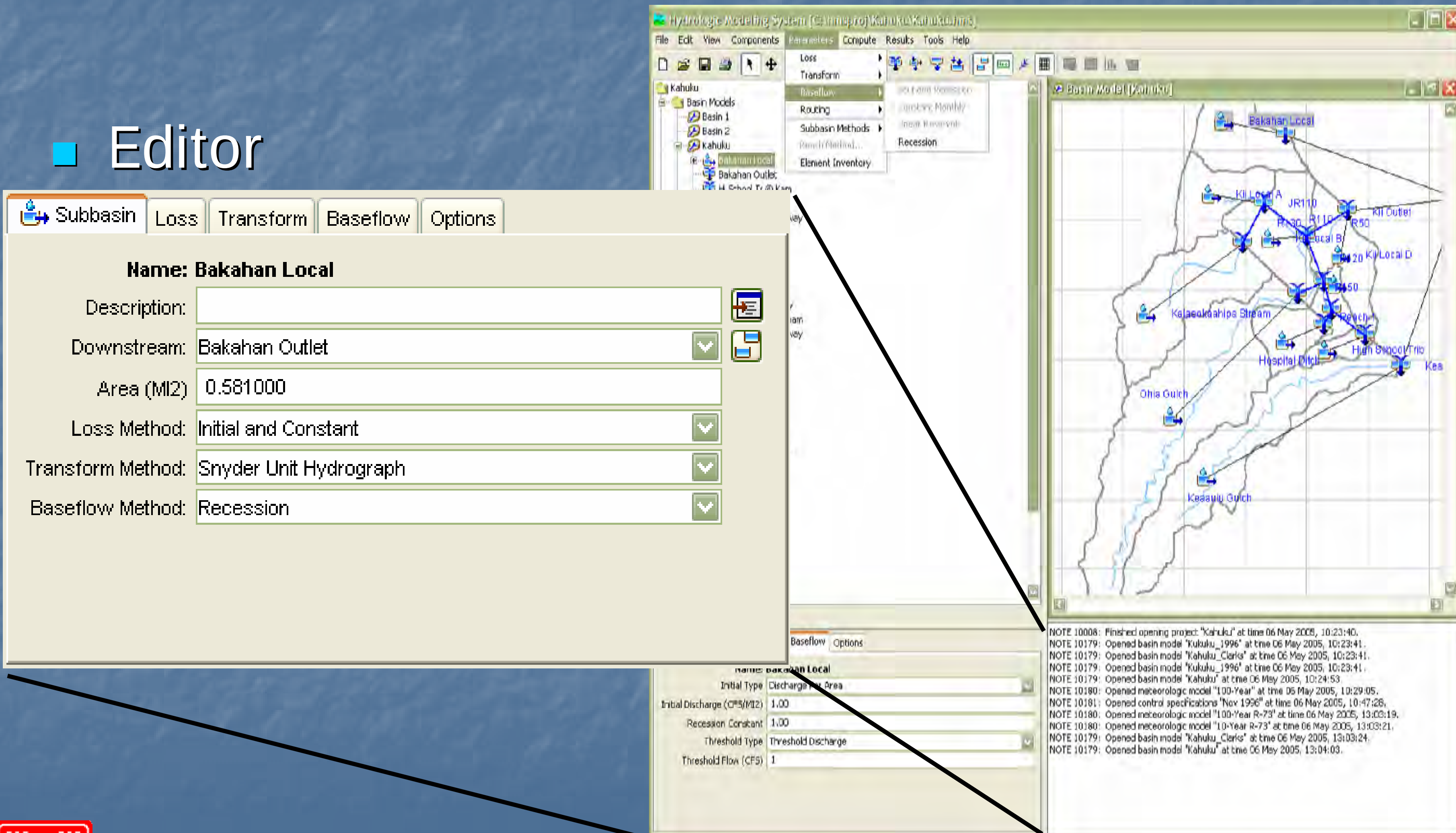
Subbasin Element

- Editor



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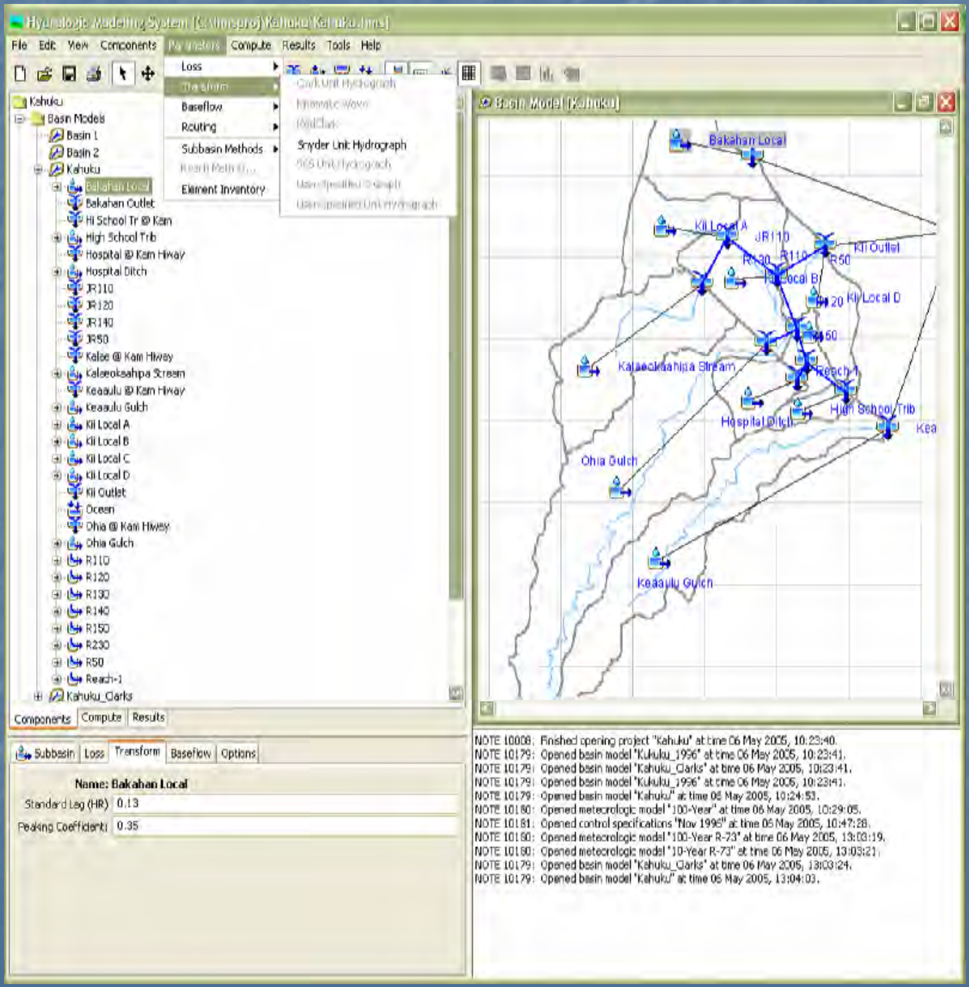
Subbasin Element Transform Parameter

- Transform Methods
  - Clark UH
  - Kinematic wave
  - ModClark
  - Snyder UH
  - SCS UH
  - User-specified S-graph
  - User-specified UH



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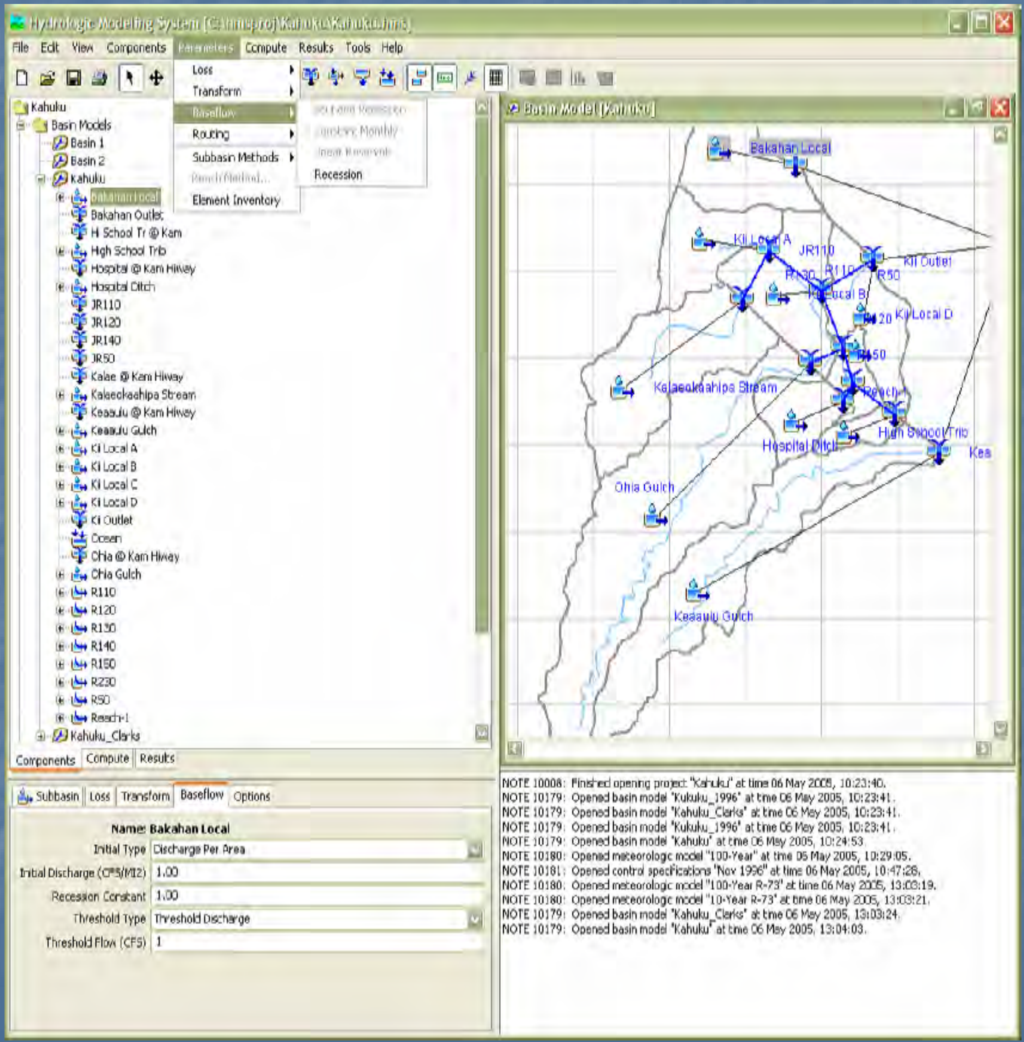
Subbasin Element Baseflow Parameter

- Baseflow Methods
  - Bounded Recession
  - Constant monthly
  - Linear reservoir
  - Recession



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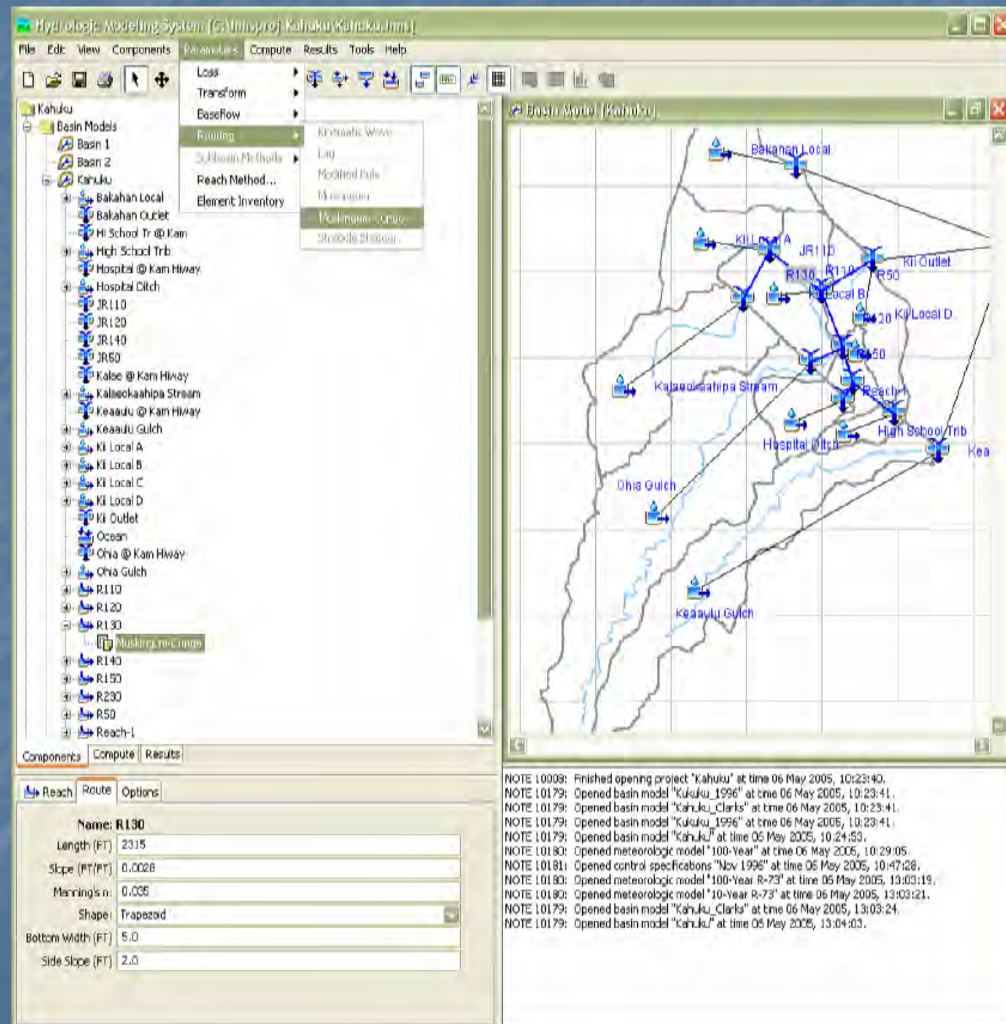
Reach Parameters

- Routing Methods
  - Kinematic Wave
  - Lag
  - Modified Puls
  - Muskingum
  - Muskingum-Cunge
  - Straddle-Stagger



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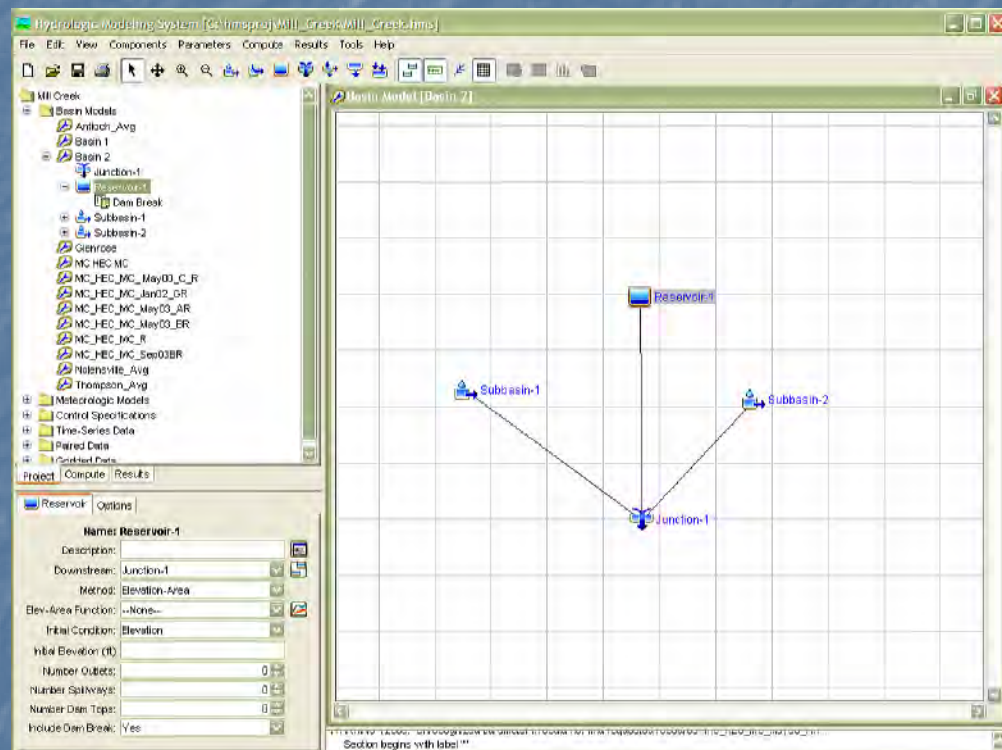
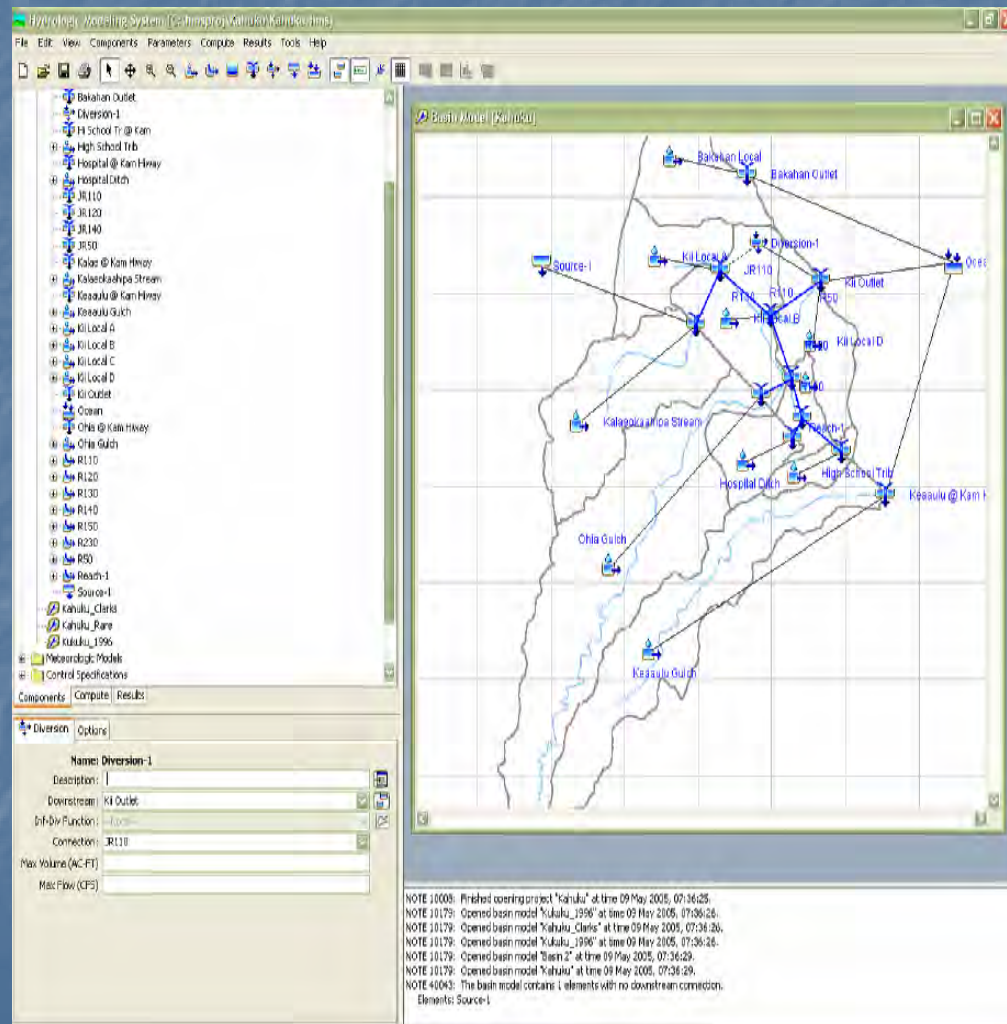
Reservoir Parameters

- Reservoir Methods
  - Simplified Routing
    - Storage-Outflow
    - Elevation-Storage-Outflow
    - Elevation-Area-Outflow
  - Detailed Routing
    - Elevation- Storage
    - Elevation-Area
      - Outlet
      - Spillway
      - Overflow
      - Dam Failure



Additional Elements

- Junction
- Diversion
- Source
- Sink



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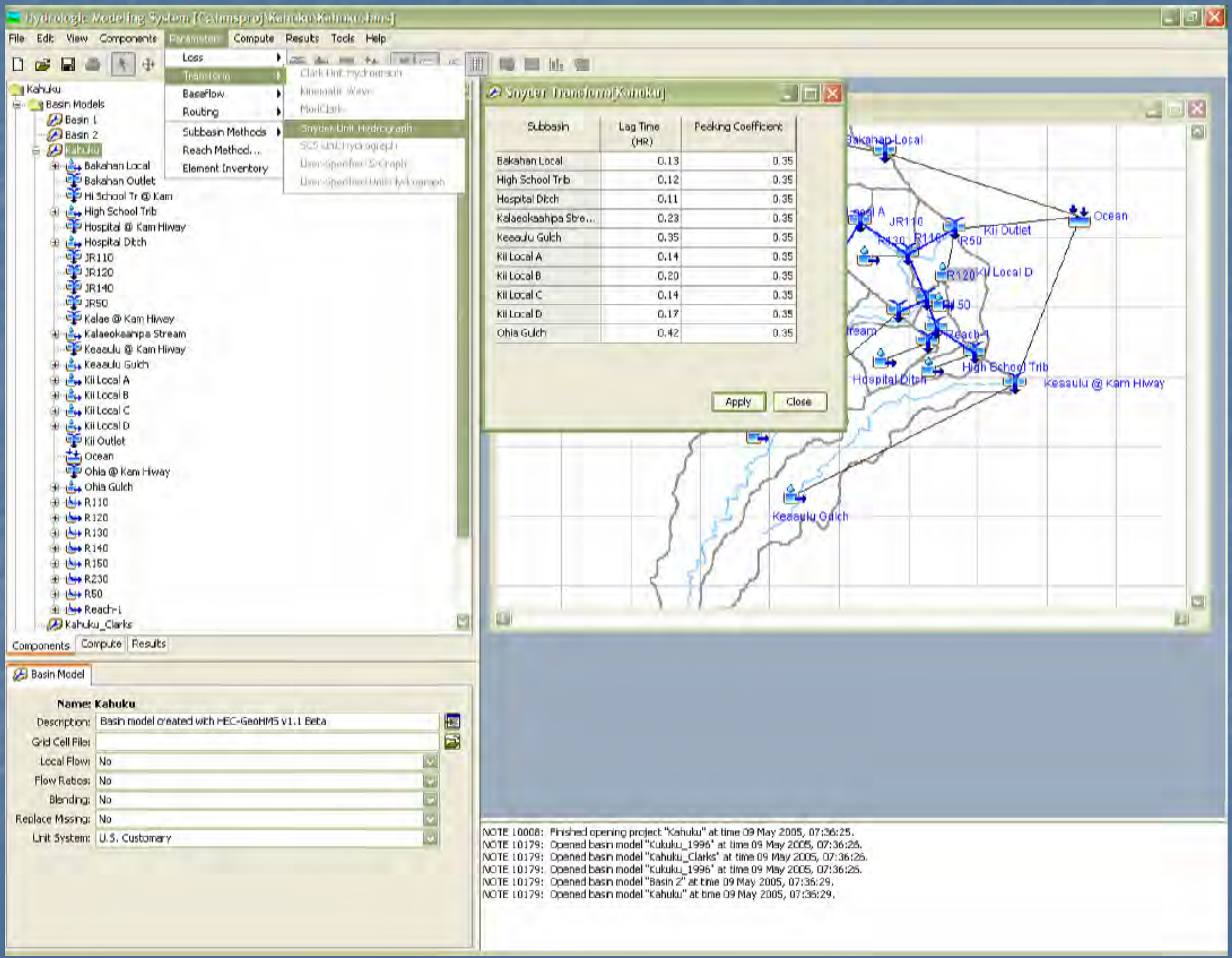
Global Editors



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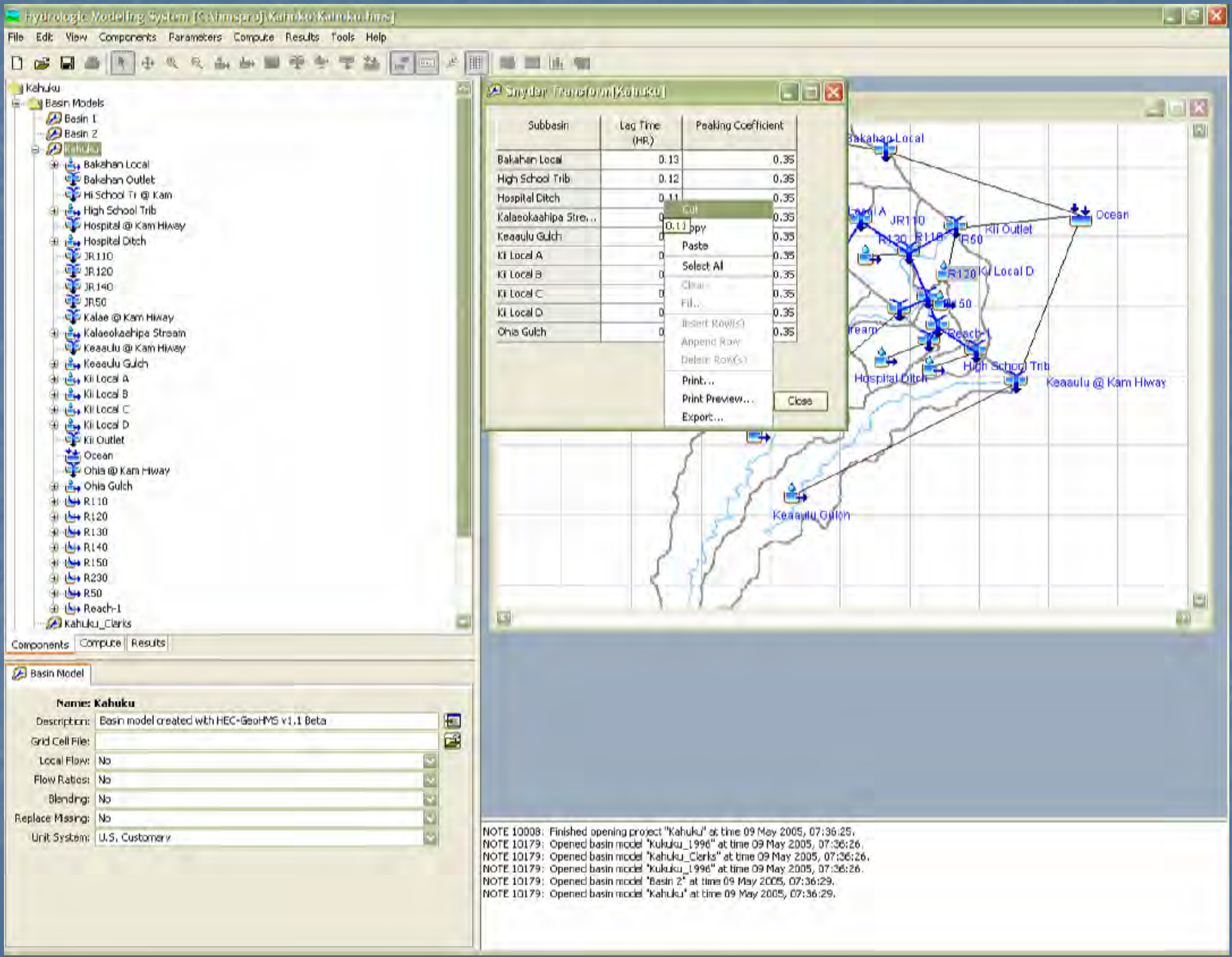

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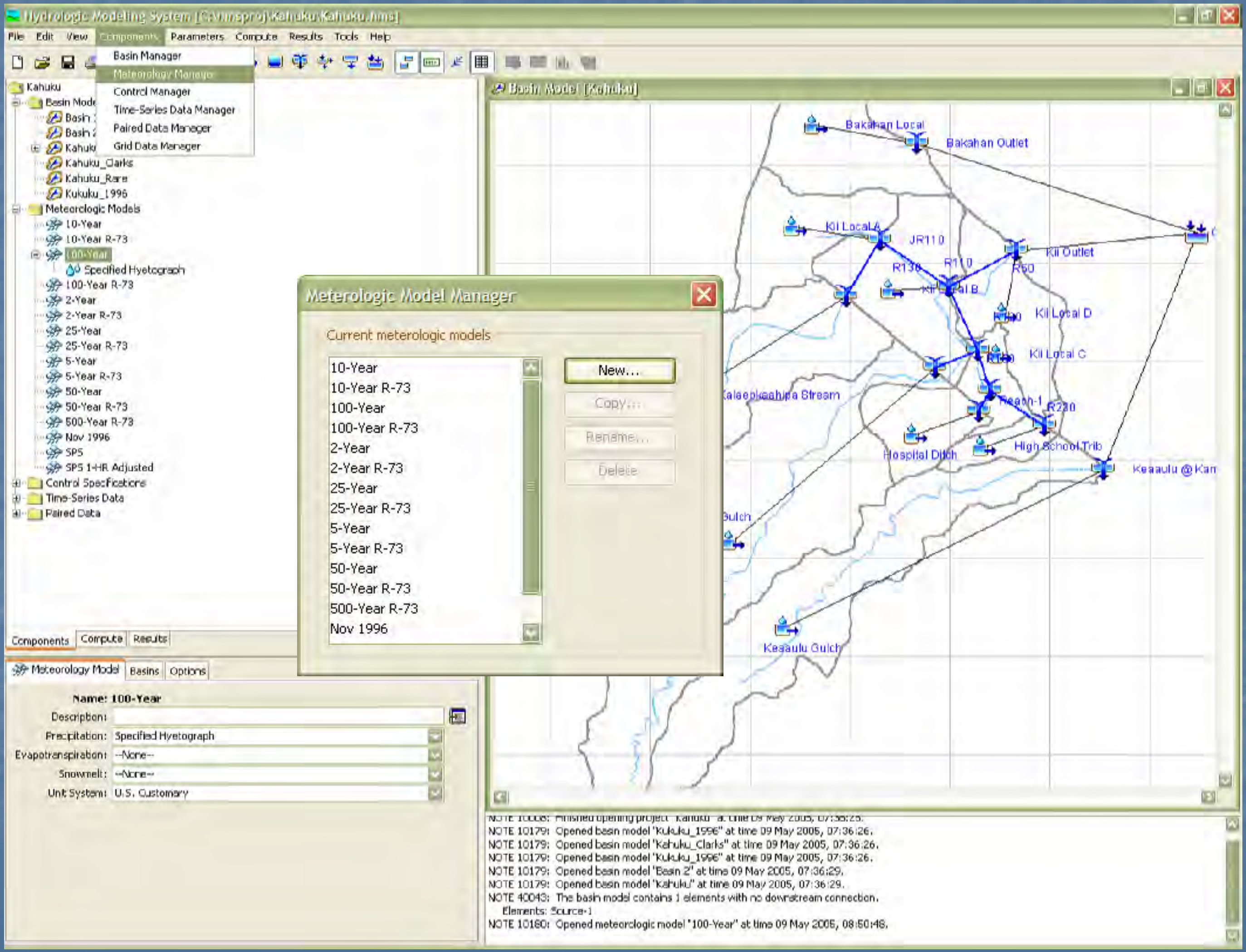
Meteorological Models



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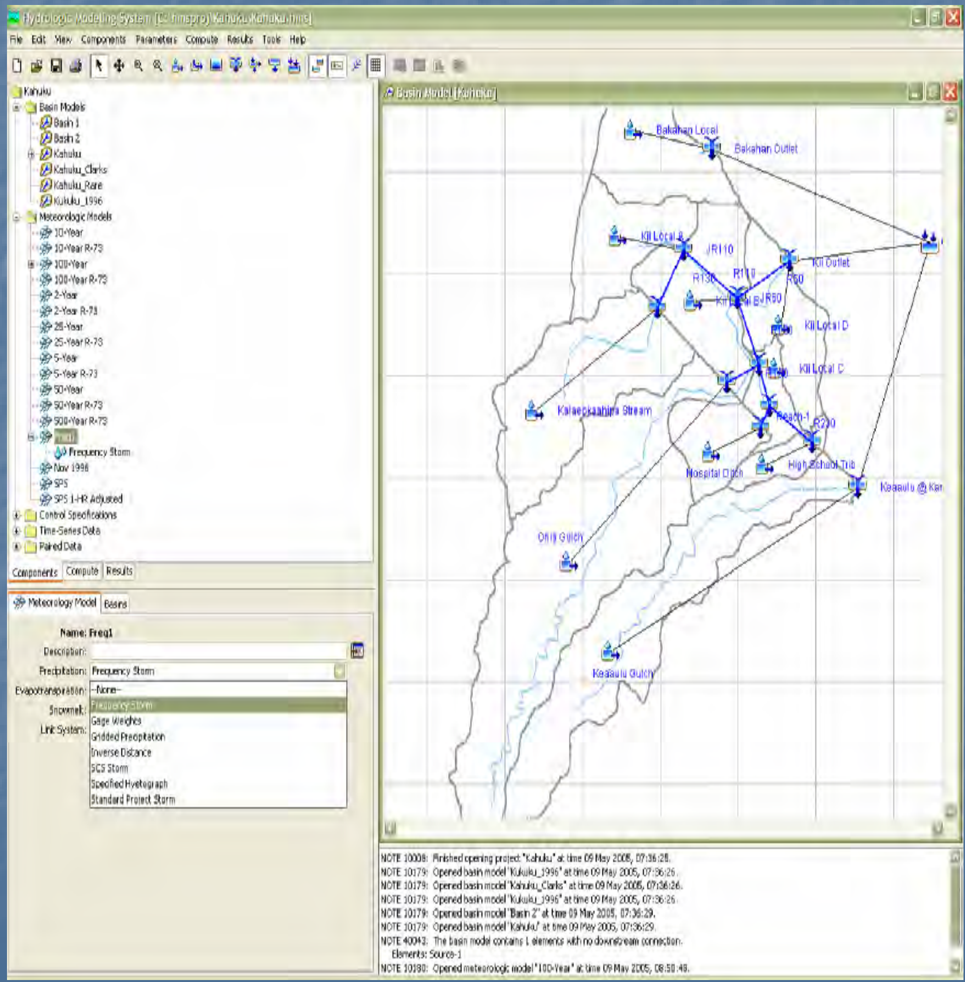
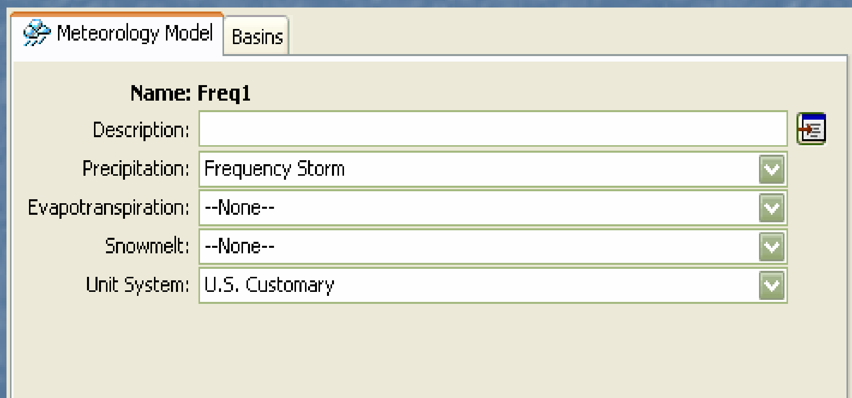
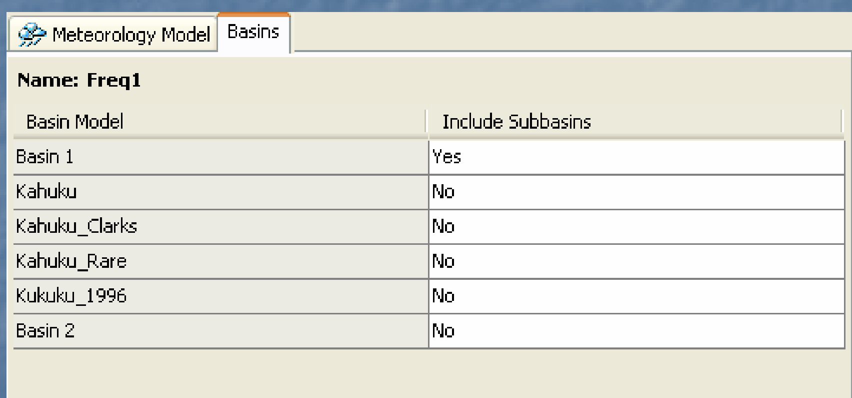
Met Model Choices

- Precipitation
  - Frequency storm
  - Gridded precipitation
  - Inverse-distance gage weighting
  - Standard project storm
  - User hyetograph
  - User-specified gage weighting

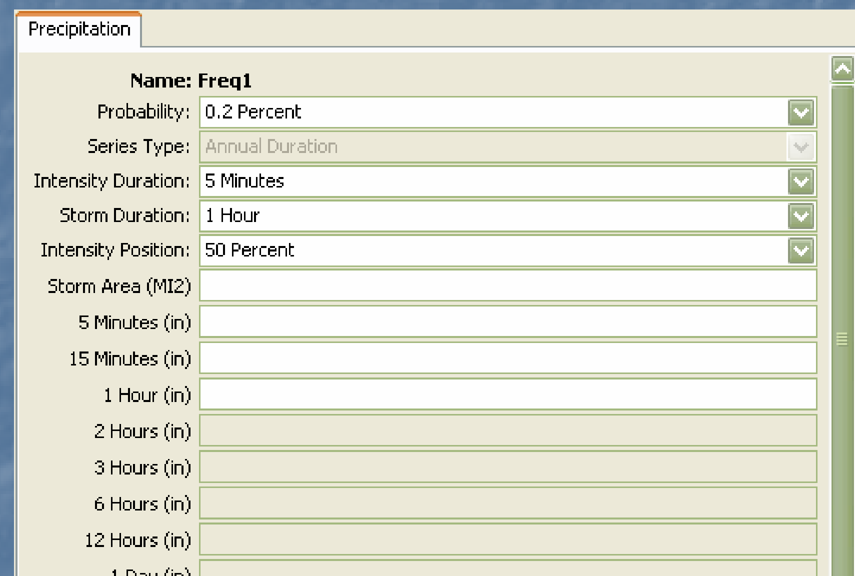


Met Model Editor





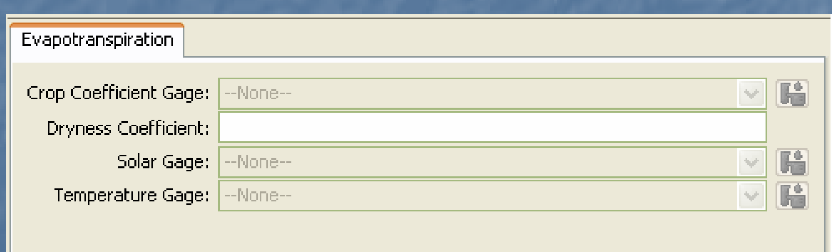
- Reflects Model Type

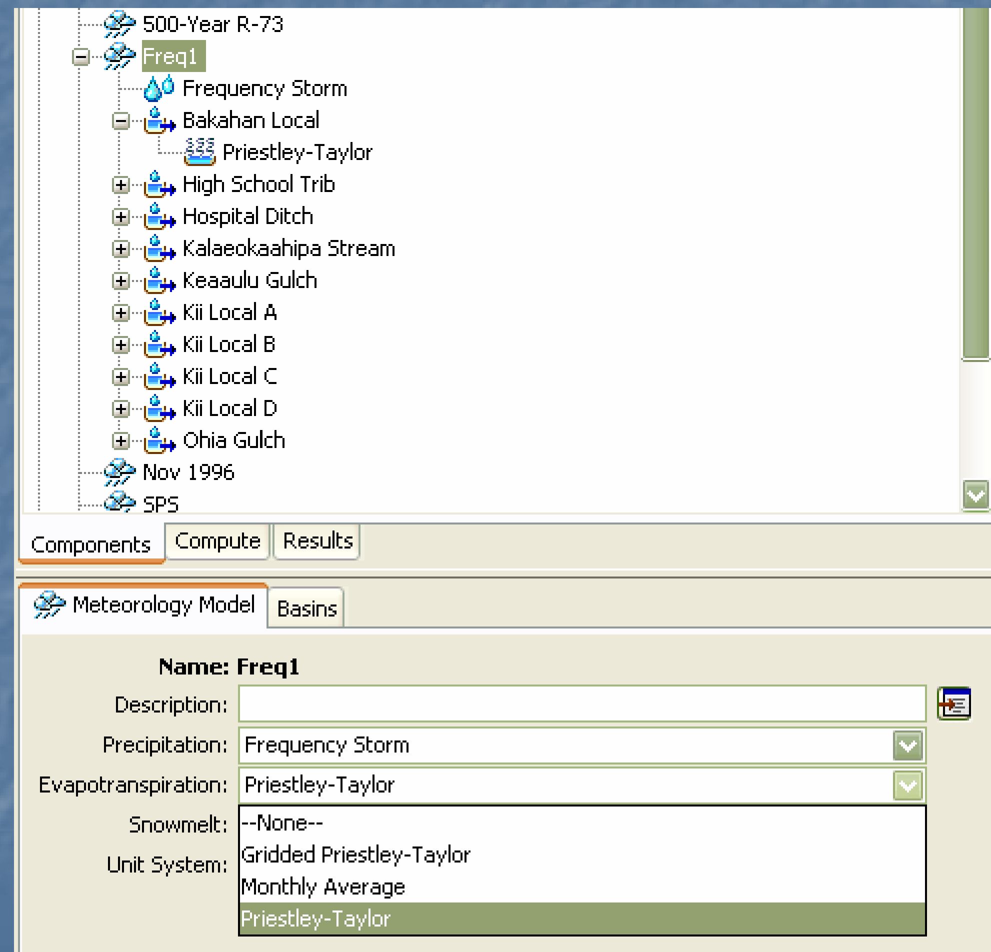


HEC

Met Model Editor

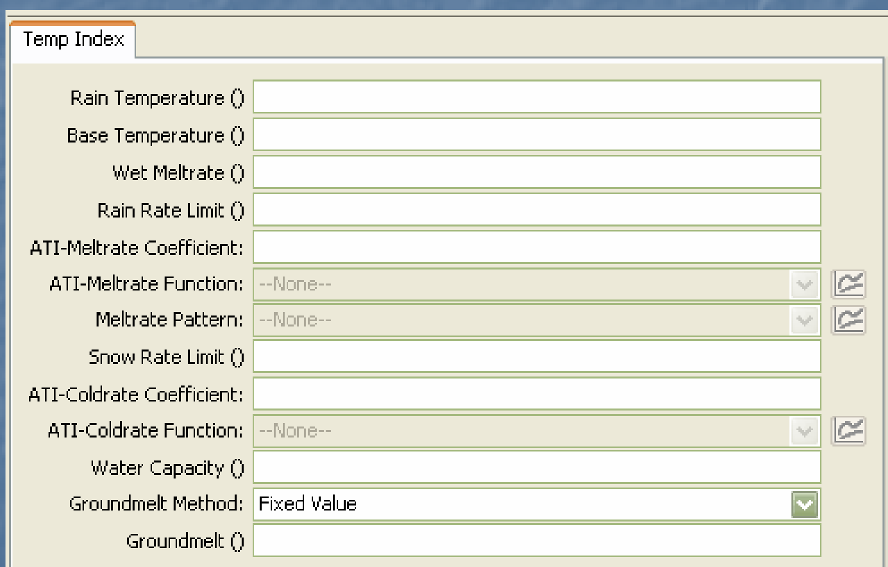
- Evapotranspiration
  - Priestly-Taylor
    - Crop Coefficient
    - Solar Radiation
    - Temperature
  - Gridded P-T
  - Monthly Average
    - Pan Coeff.
    - Rate

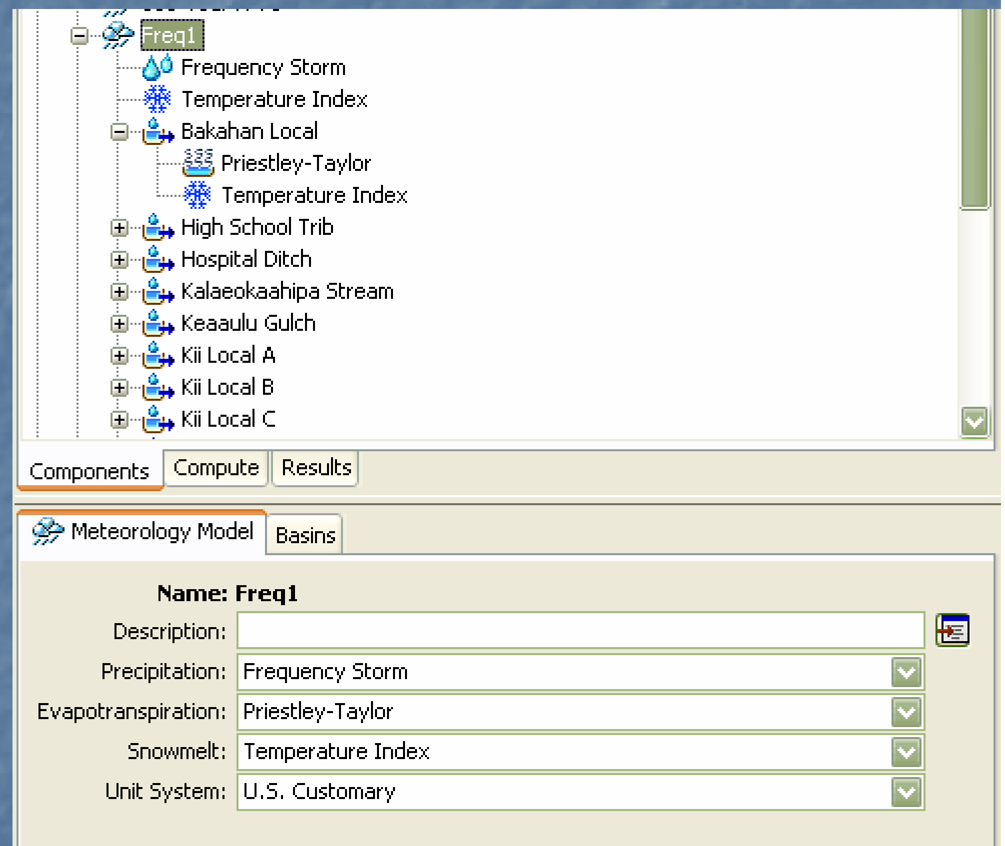




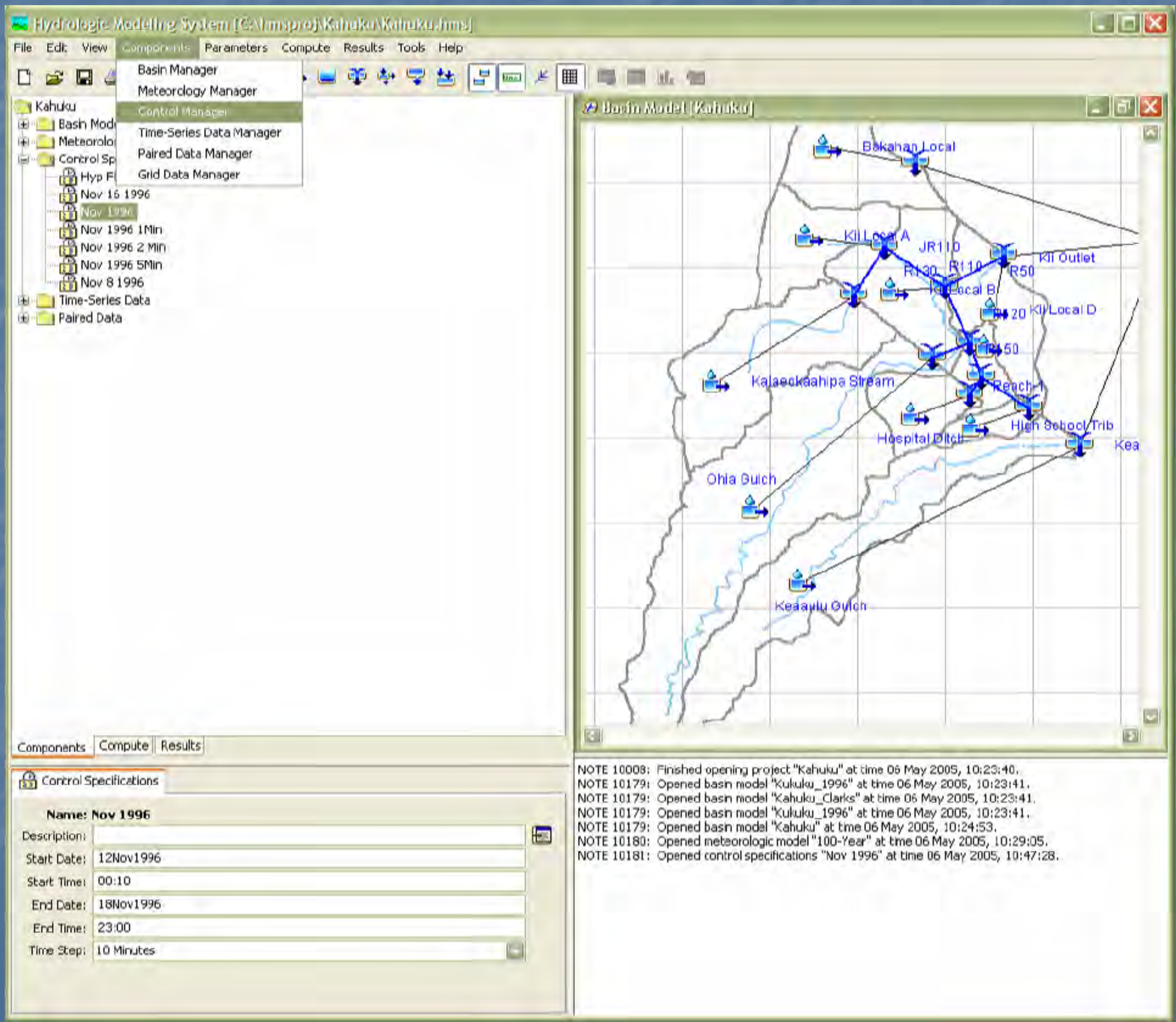
Met Model Editor

- Snowmelt
  - Temperature Index
  - Gridded Temp Index





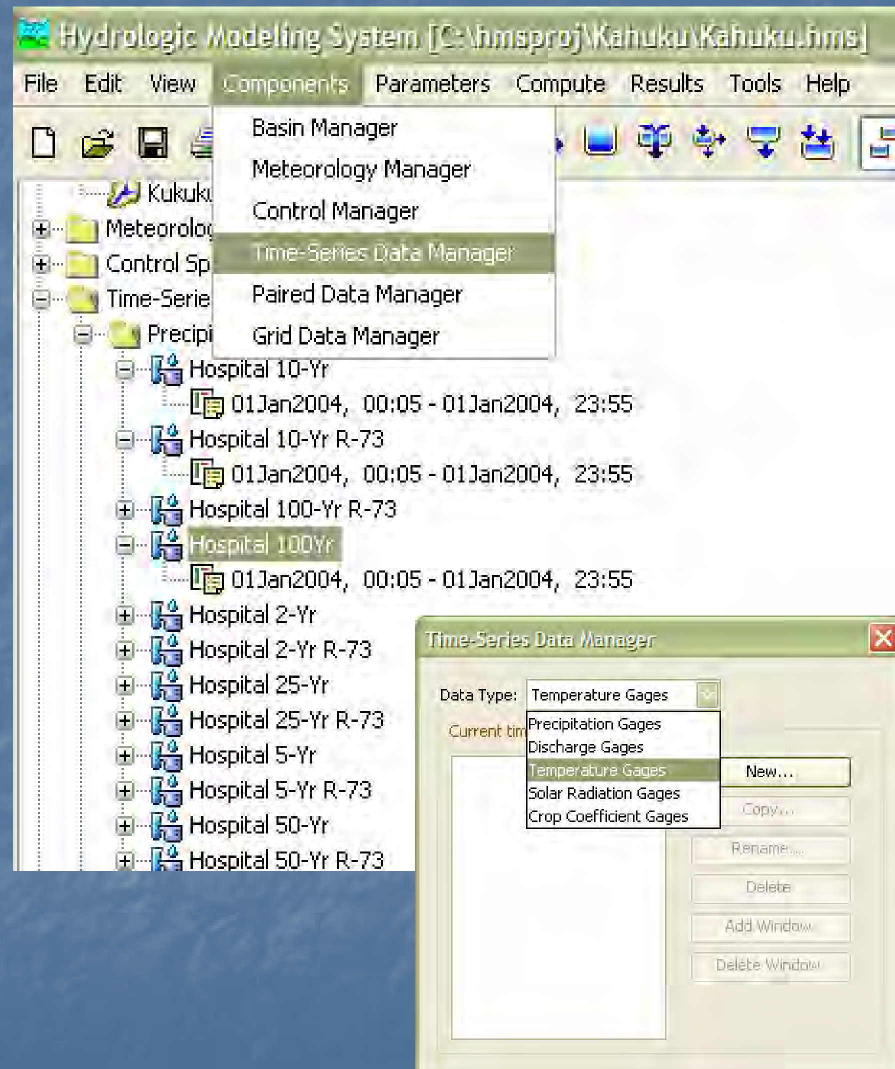
Control Specifications

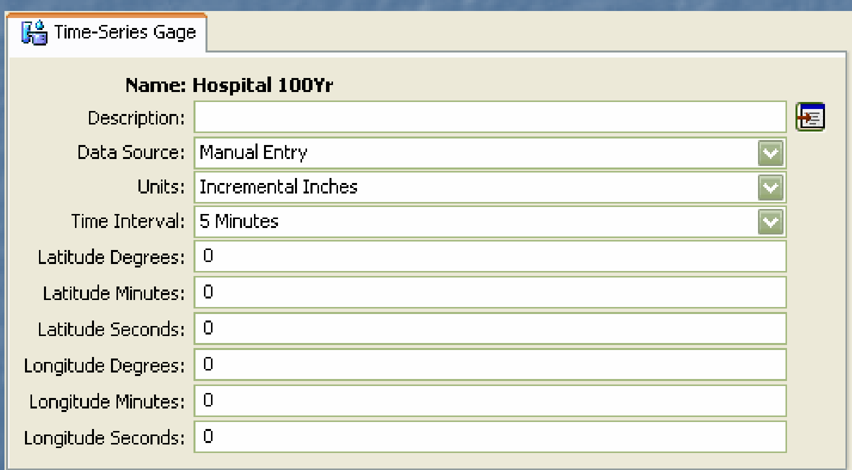


HEC

Time Series Data

- Types
  - Precipitation
  - Discharge
  - Temperature
  - Solar radiation
  - Crop Coefficient

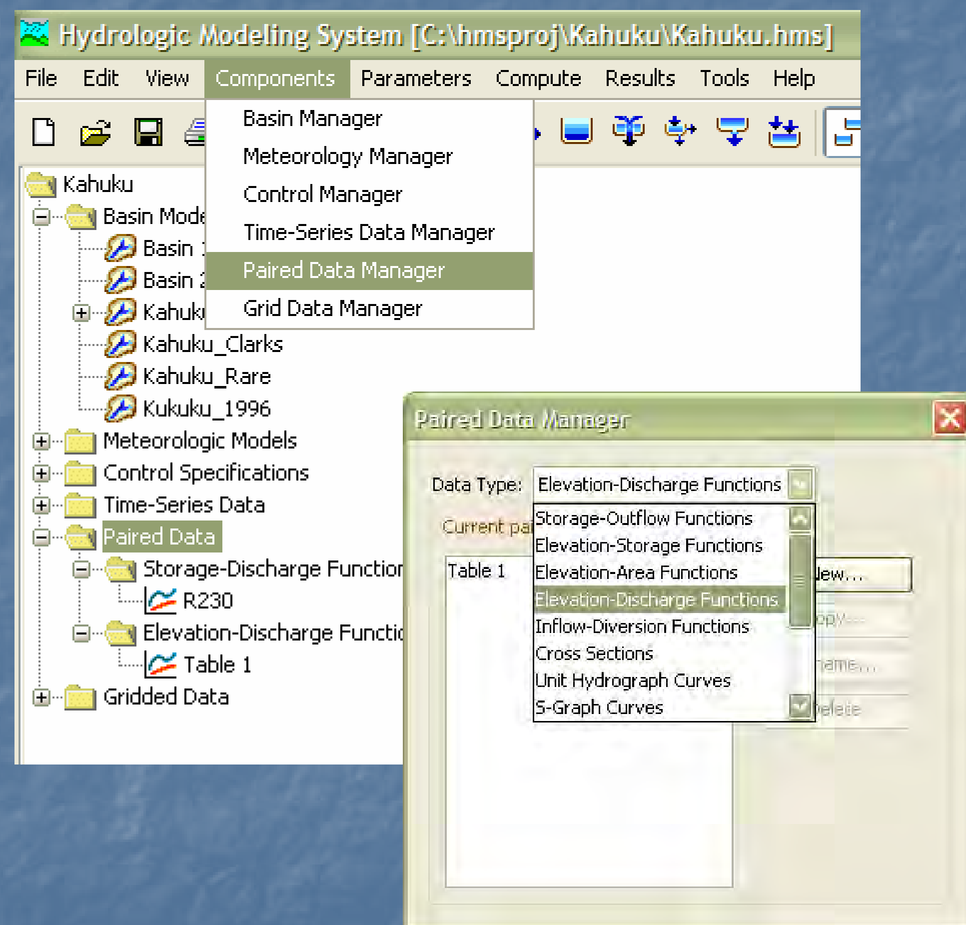




HEC

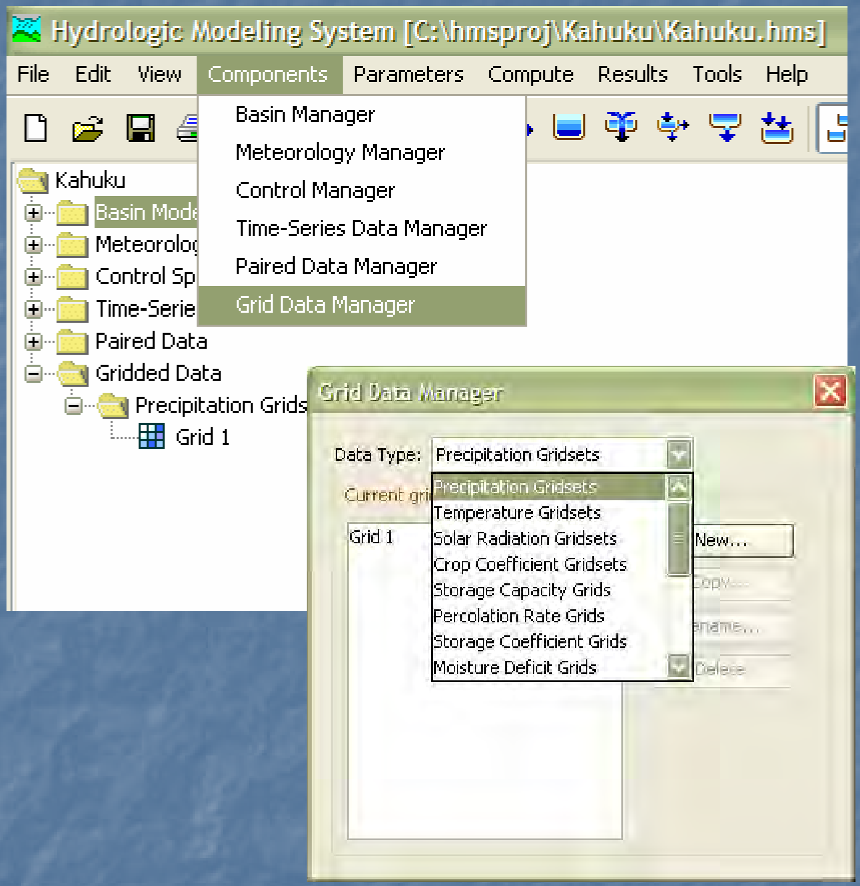
Paired Data

- Types
  - Storage-Outflow
  - Elevation Storage
  - Elevation-Area
  - Elevation-Discharge
  - Inflow-Diversion
  - Cross Sections
  - Unit Hydrograph
  - S-Graph
  - ATI Meltrate
  - ATI Coldrate
  - Groundmelt Patterns
  - Evaporation Patterns
  - Meltrate patterns



Gridded Data

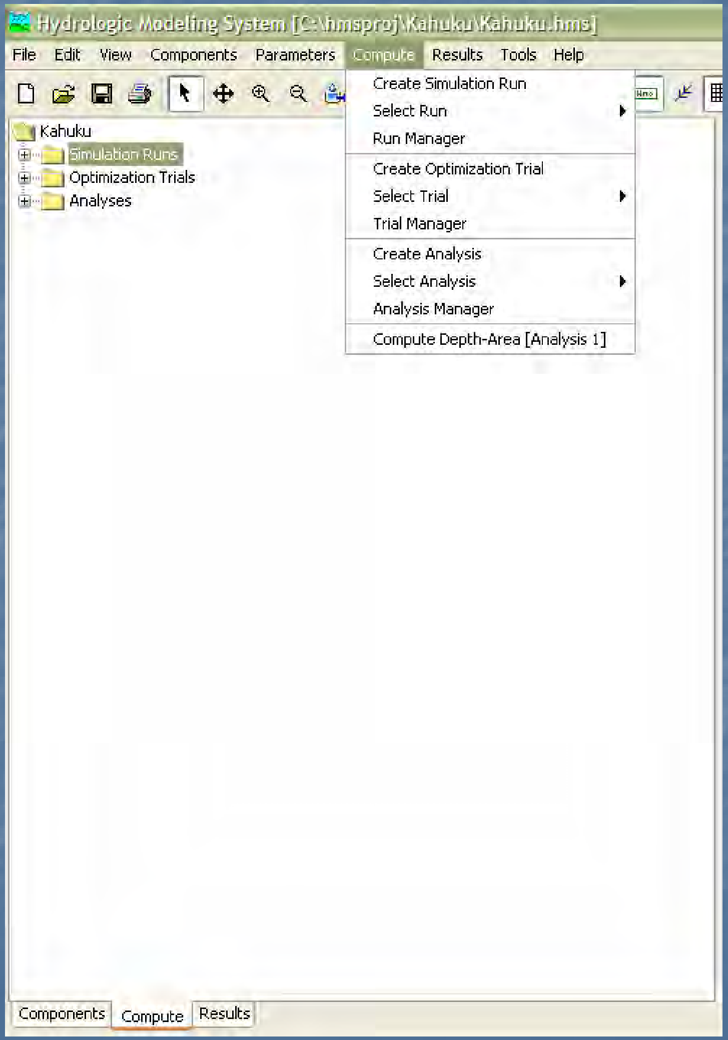
- Types
  - Precipitation
  - Temperature
  - Solar radiation
  - Crop Coefficient
  - Storage Capacity
  - Percolation
  - Storage Coefficient
  - Moisture Deficit
  - Impervious Area
  - SCS Curve Number
  - Elevation
  - Cold Content
  - Cold Content ATI
  - Meltrate ATI
  - Liquid Water Content
  - Snow Water Equivalent
- Data Source always DSS



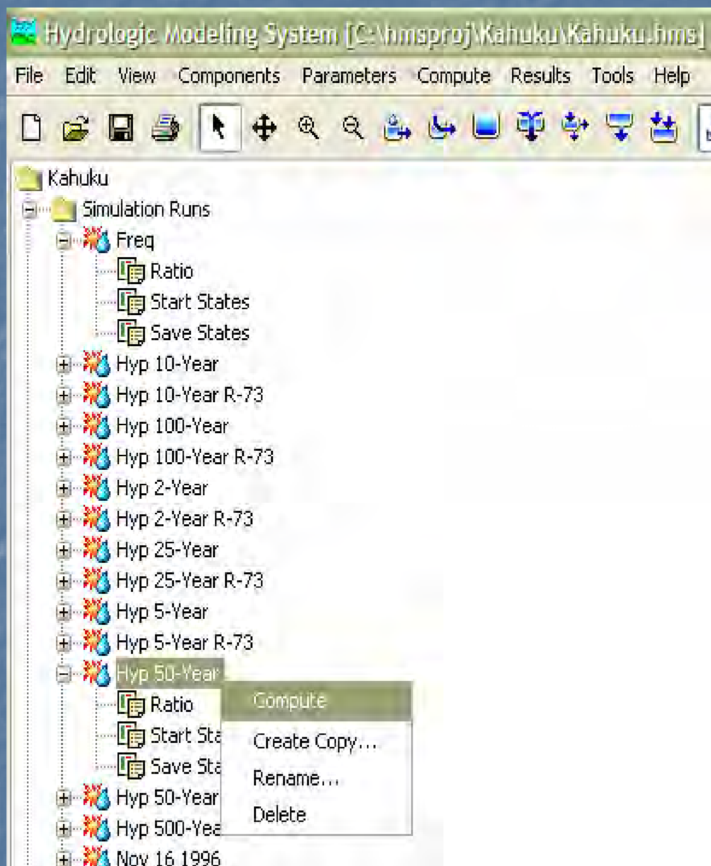
HEC

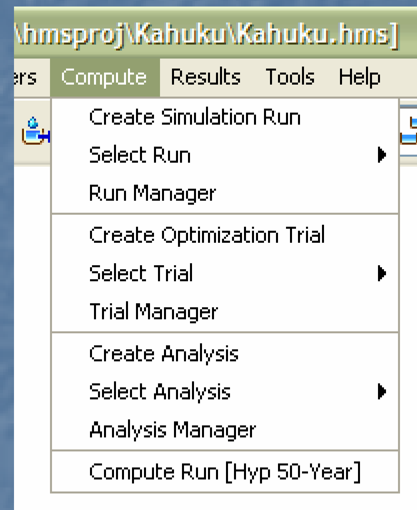
Model Computations

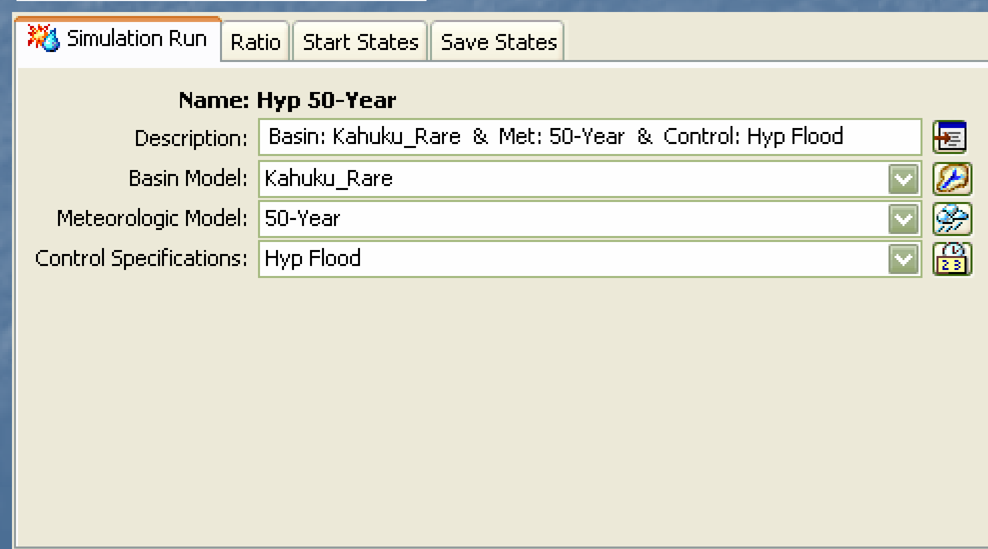
- Simulation
- Optimization
- Depth-Area Analysis



Simulation



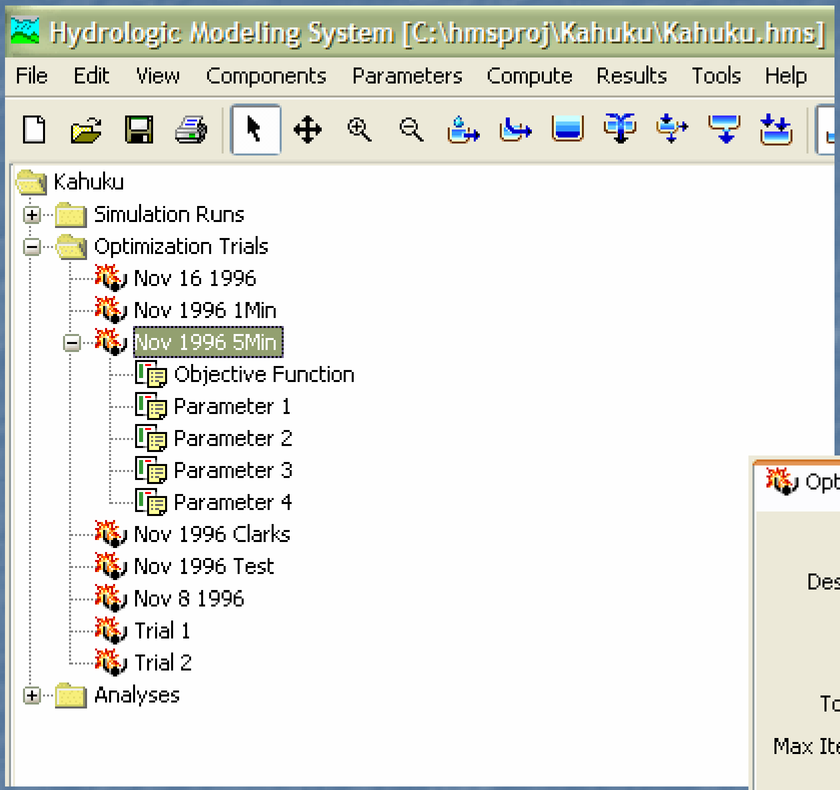


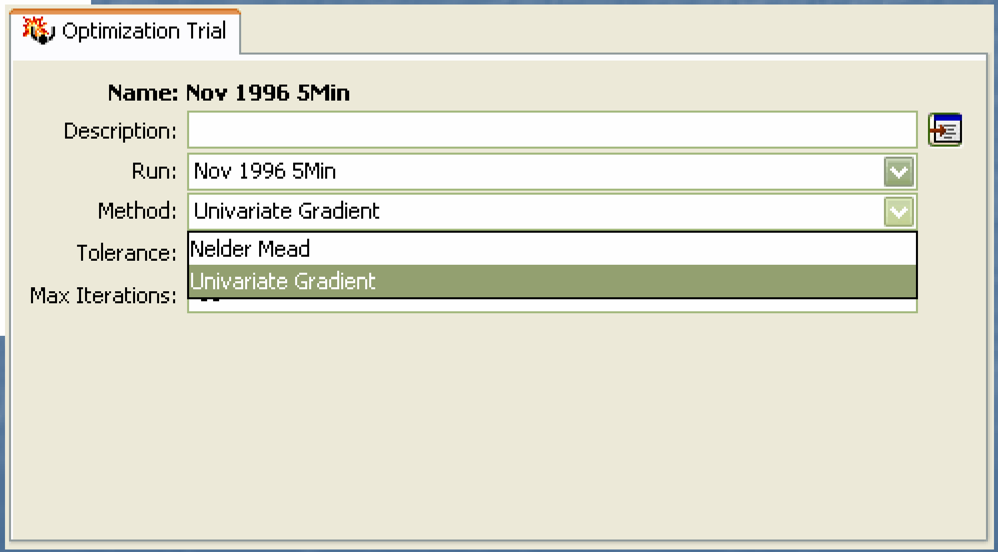


HEC

Optimization

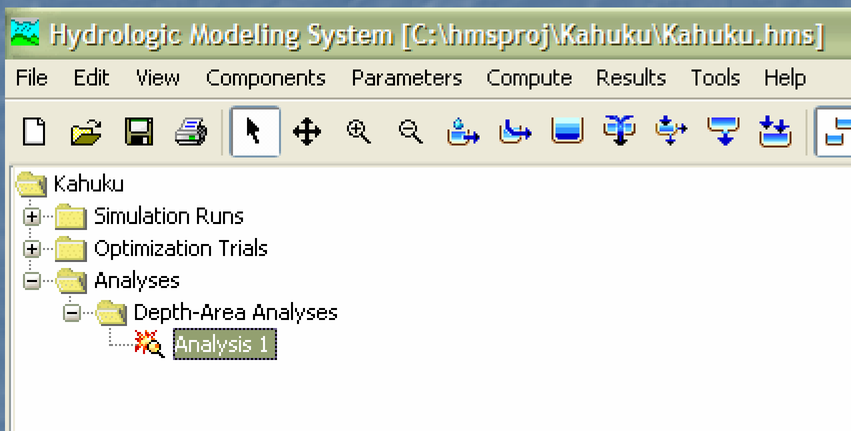
- Observed Data
- Existing Simulation



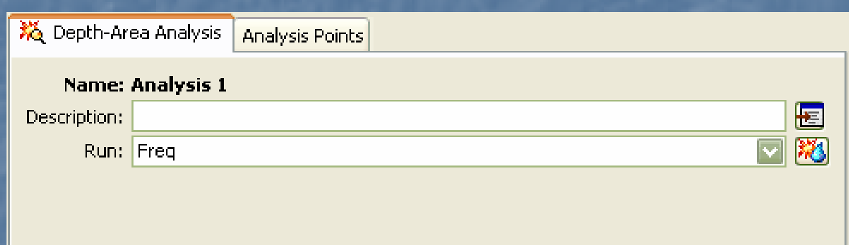


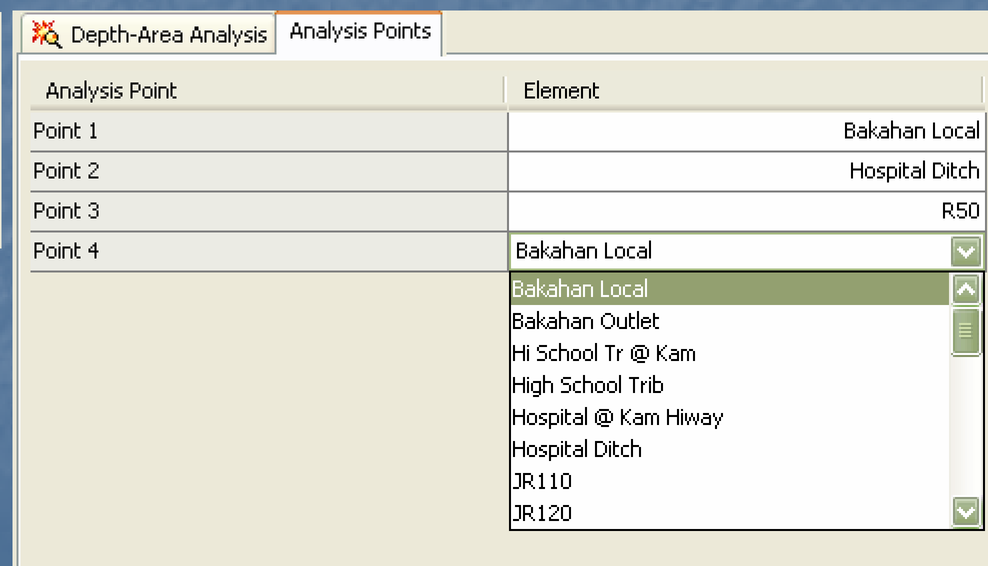
HEC

Depth-Area Analysis



- Based on Existing Simulation
- Frequency Storm Met Model





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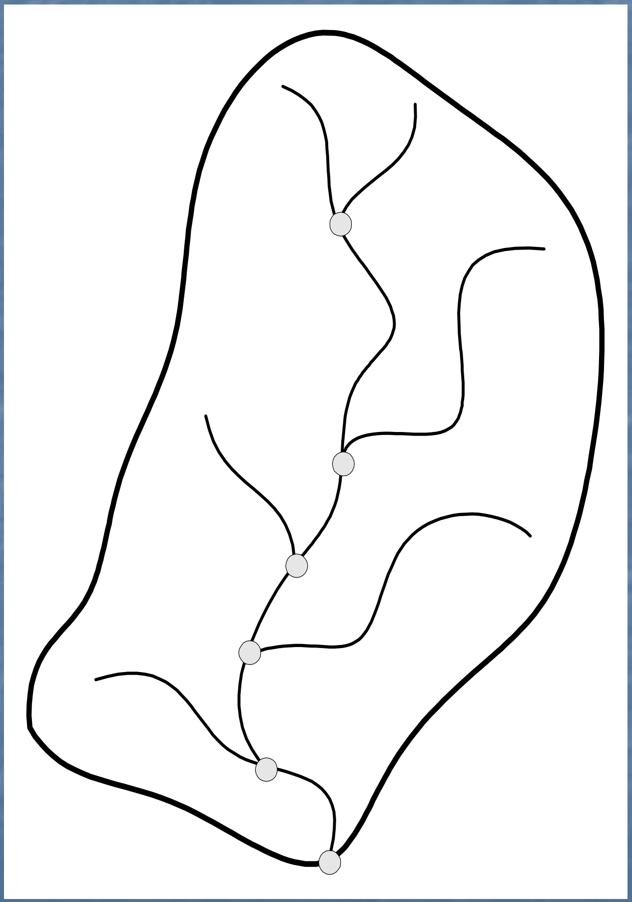
Depth-Area Analysis

- Frequency Storm Application Basis for Many Planning Studies
- Multiple Evaluation Locations Almost Always Necessary
- New Tool Provides Semi-Automated Analysis at Multiple Evaluation Locations
- Will Reduce Errors from Improperly Applied Storms
- Reduce Time to Evaluate Multiple Locations



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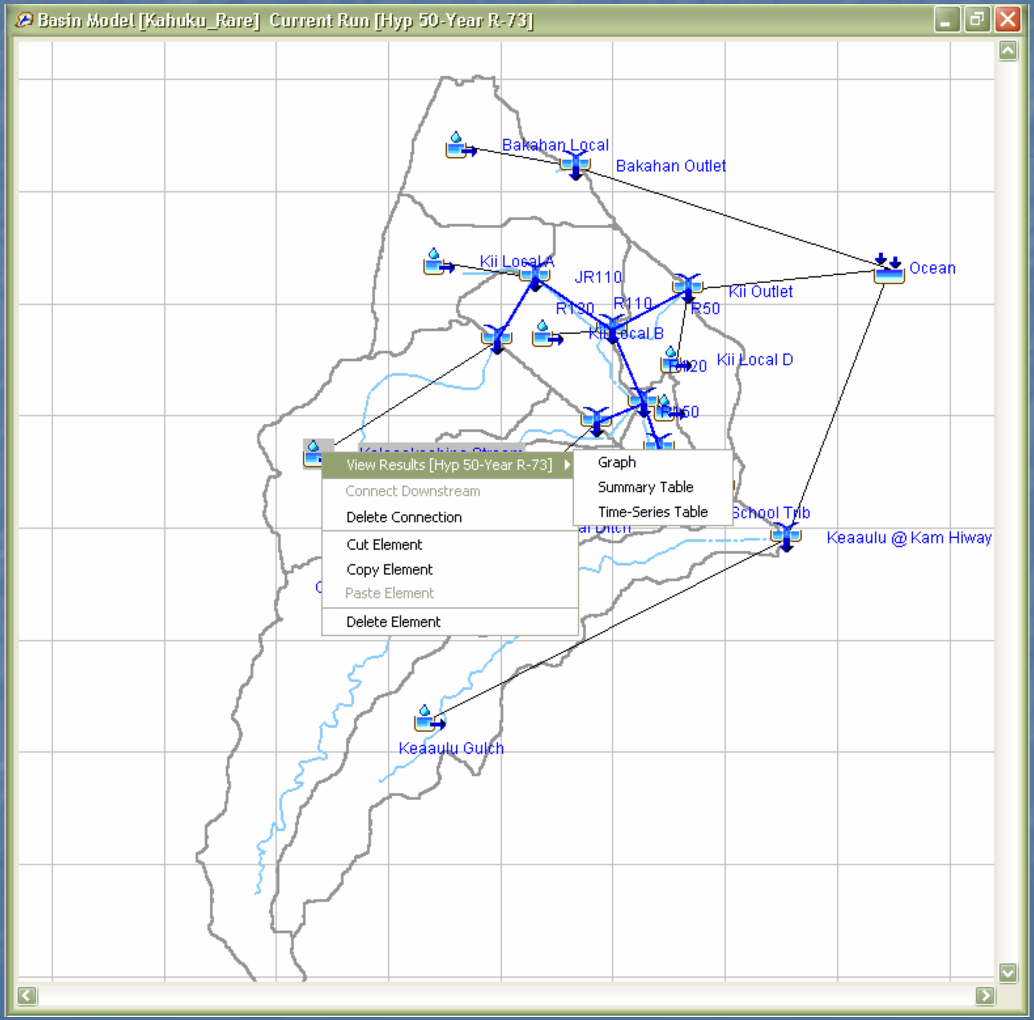
Simulation Results – Basin Map

- Based on Last Compute
  - For Selected Element
    - Graph
    - Summary Table
    - Time Series table
  - Preset Graphs, Tables
    - Based on Element



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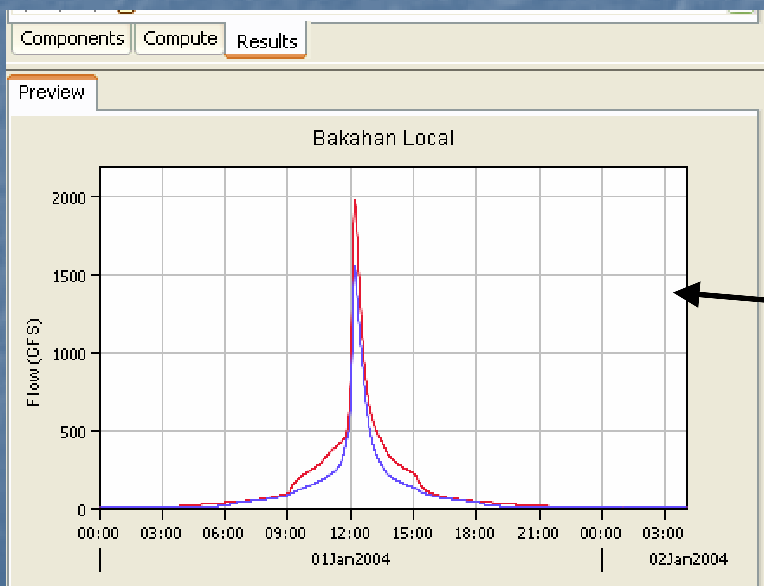
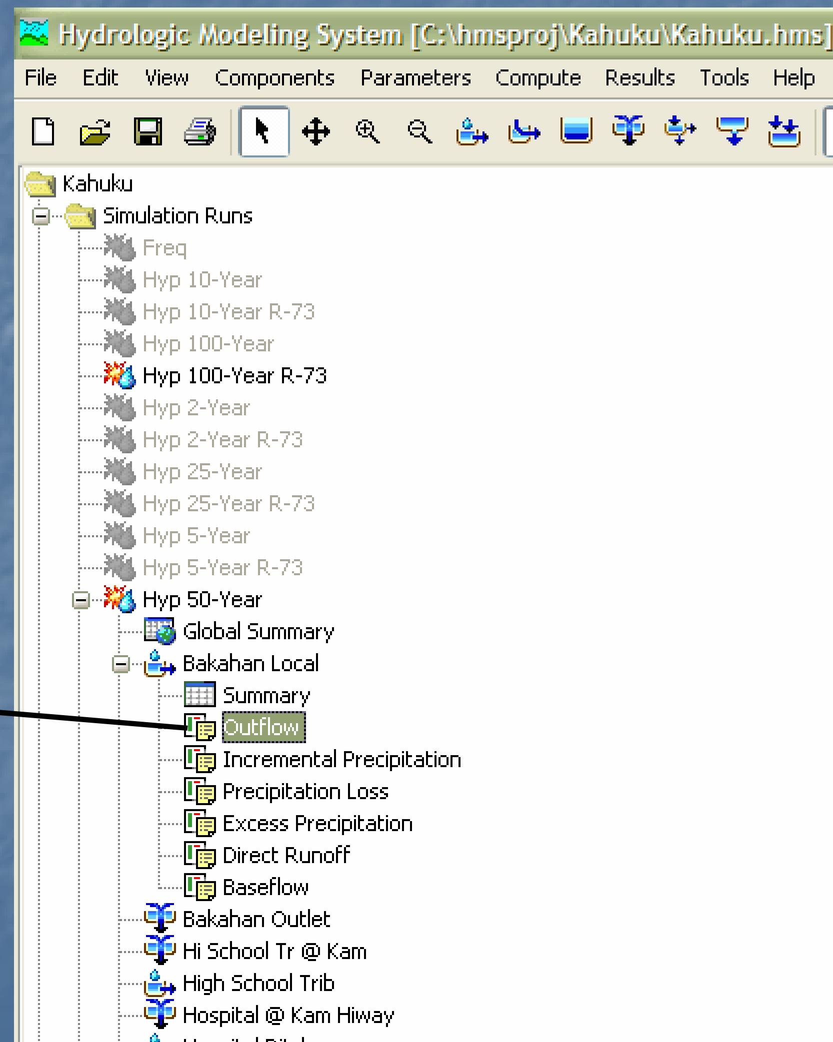
Simulation Results – Results Tree

- Valid Results Enabled
- Compare Multiple Runs
- Plot in Preview Window
- Expand to Large Plot

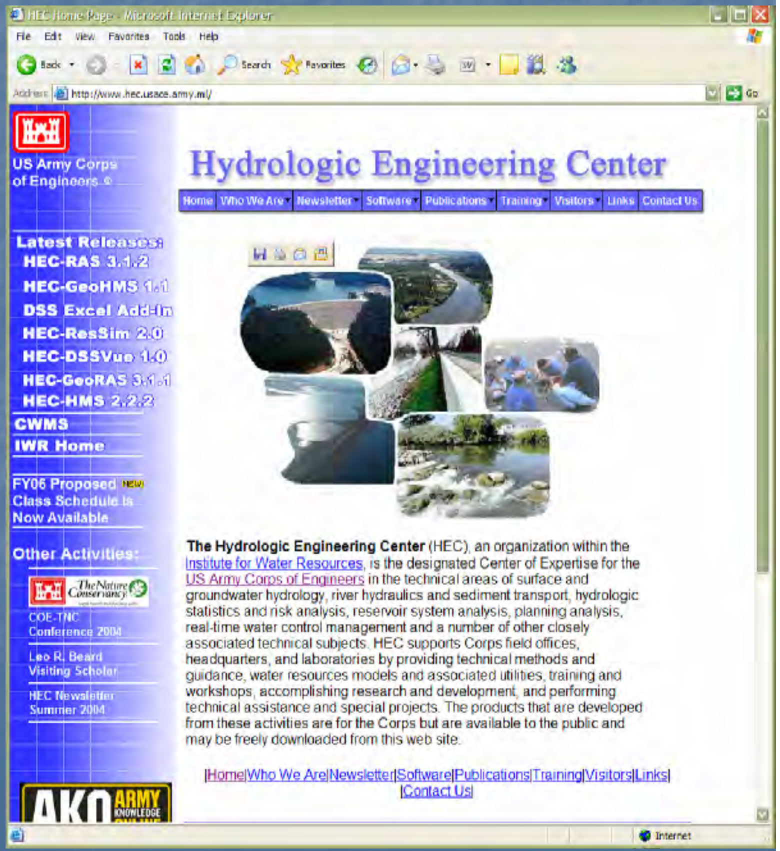




HEC

HEC-HMS Web Access

- Download HEC-HMS from HEC Website
  - http://www.hec.usace.army.mil/
- Beta Version HMS 3.0
  - Released and in test phase
- 2003 Statistics
  - 37,000 Downloads
  - 93 Countries



HEC

Contact Info

- Jeff Harris
- US Army Corps of Engineers

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Davis, CA 95616
530-756-1104
david.j.harris@usace.army.mil

HEC Support of the CMEP Program

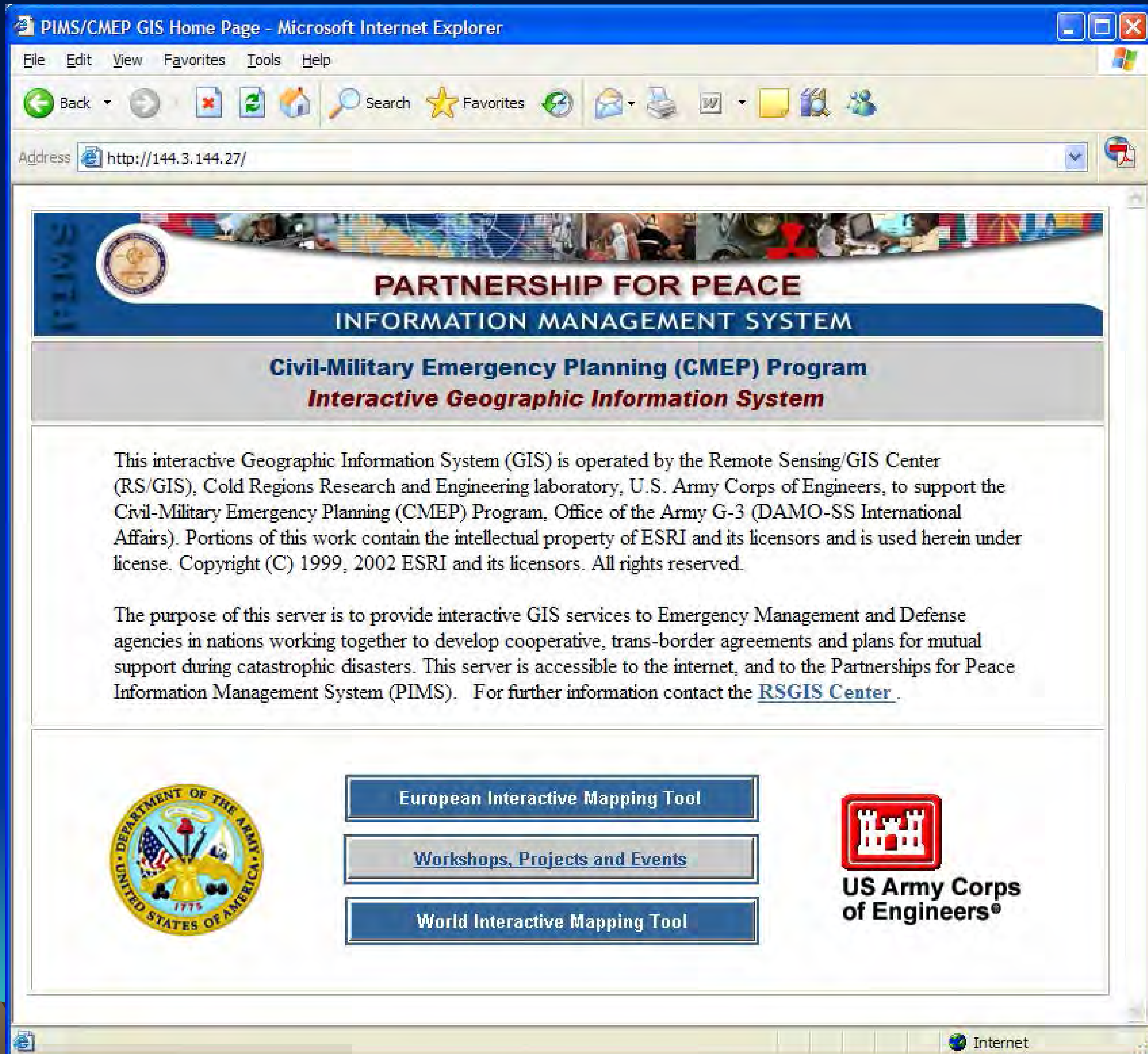
Mark Jensen

CMEP
Civil/Military Emergency Preparedness

- Program that coordinates training of emergency operation centers in former Soviet block states and encourages a transition from military to civil departments
- Created after the nuclear power plant disaster at Chernobyl
- Directed from the USACE Europe District office in Wiesbaden Germany
- Funded by NATO and their Partnership for Peace program

CMEP Program Mission

- Program goal is to encourage non-NATO nations to work together, and prepare in advance in the event that one of these countries has an emergency and would benefit from support from their neighbors.
- GIS technology is one vehicle used to focus on sharing information and working together


PIMS/CMEP GIS Home Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://144.3.144.27/
PARTNERSHIP FOR PEACE
INFORMATION MANAGEMENT SYSTEM
Civil-Military Emergency Planning (CMEP) Program
Interactive Geographic Information System
This interactive Geographic Information System (GIS) is operated by the Remote Sensing/GIS Center (RS/GIS), Cold Regions Research and Engineering laboratory, U.S. Army Corps of Engineers, to support the Civil-Military Emergency Planning (CMEP) Program, Office of the Army G-3 (DAMO-SS International Affairs). Portions of this work contain the intellectual property of ESRI and its licensors and is used herein under license. Copyright (C) 1999, 2002 ESRI and its licensors. All rights reserved.
The purpose of this server is to provide interactive GIS services to Emergency Management and Defense agencies in nations working together to develop cooperative, trans-border agreements and plans for mutual support during catastrophic disasters. This server is accessible to the internet, and to the Partnerships for Peace Information Management System (PIMS). For further information contact the RSGIS Center .
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US Army Corps of Engineers®
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Typical CMEP Exercise

Meeting (~1 week)	Location
Orientation	Wiesbaden, Germany (Europe USACE district)
IPC – Initial Planning Conference	Wiesbaden, Germany or Host Country
MPC – Main Planning Conference	Host Country
TTX – Table Top Exercise	Host Country

Typical CMEP Exercise

- Host country has ~dozen emergency managers and a few GIS specialists
- 4-6 delegations from neighboring countries
- Neighbor country delegations are a few emergency managers and a few GIS specialists
- Exercise has ~40 people

CMEP Program Schedule 2005

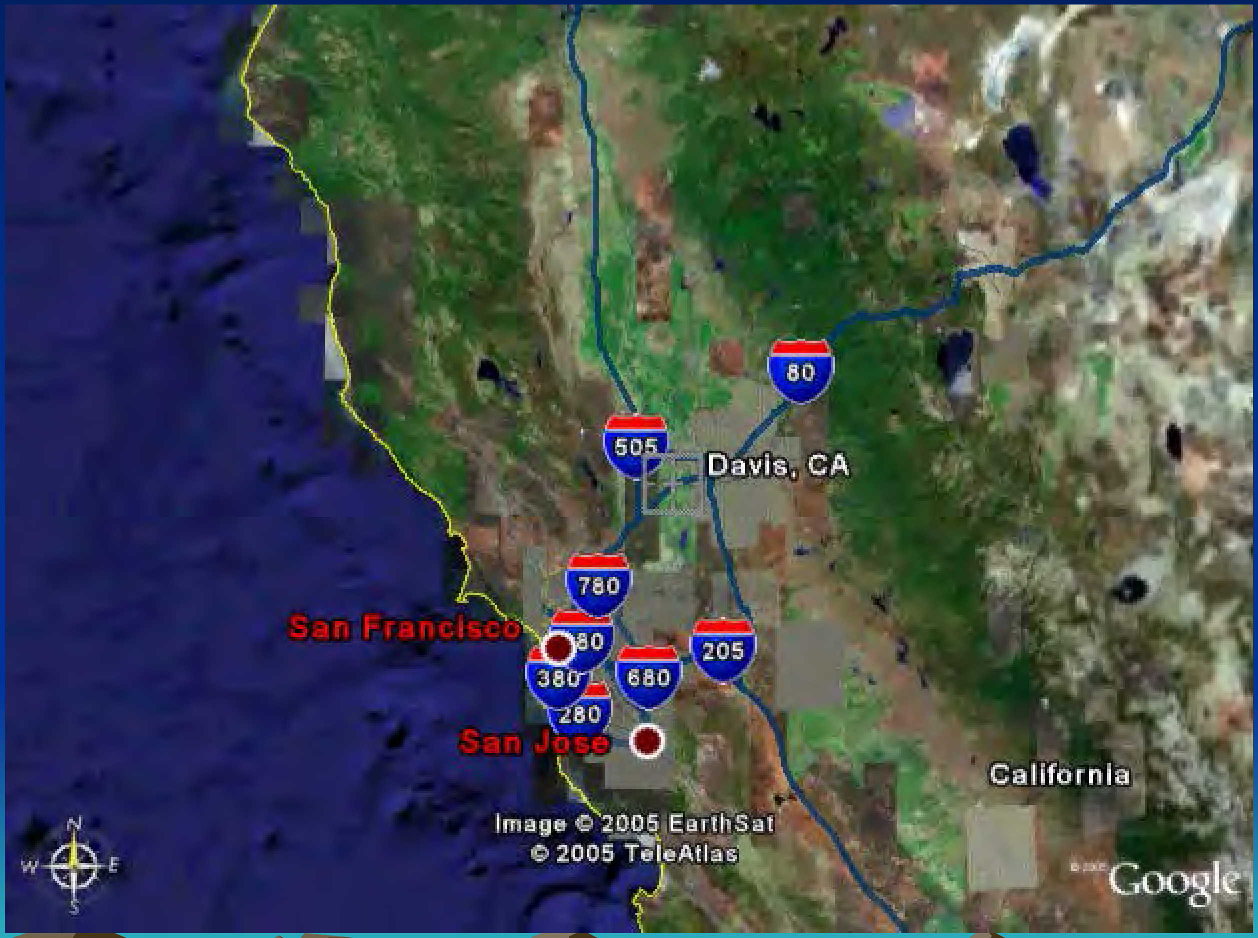
- Romania
- Latvia
- Bosnia-Herzegovina
- Macedonia
- Moldova
- Kyrgyzstan
- Black Sea Strategy (Countries around the Black Sea)

HEC Participation in CMEP

- HEC has been invited to be GIS facilitators for CMEP exercises with dam break disaster scenarios or other Hydrology and Hydraulics issues

- Thus far we have worked with delegations from:
  - Armenia
  - Tajikistan
  - Latvia
  - Bosnia and Herzegovina

World Tour (Thanks, Google Earth)



GIS Facilitator

- CMEP has a strong GIS component and the exercises illustrate how it can be used in emergency management
- CMEP Facilitators advance their GIS knowledge and capabilities
  – General lecture's to entire group
  – More technical discussions with GIS working groups

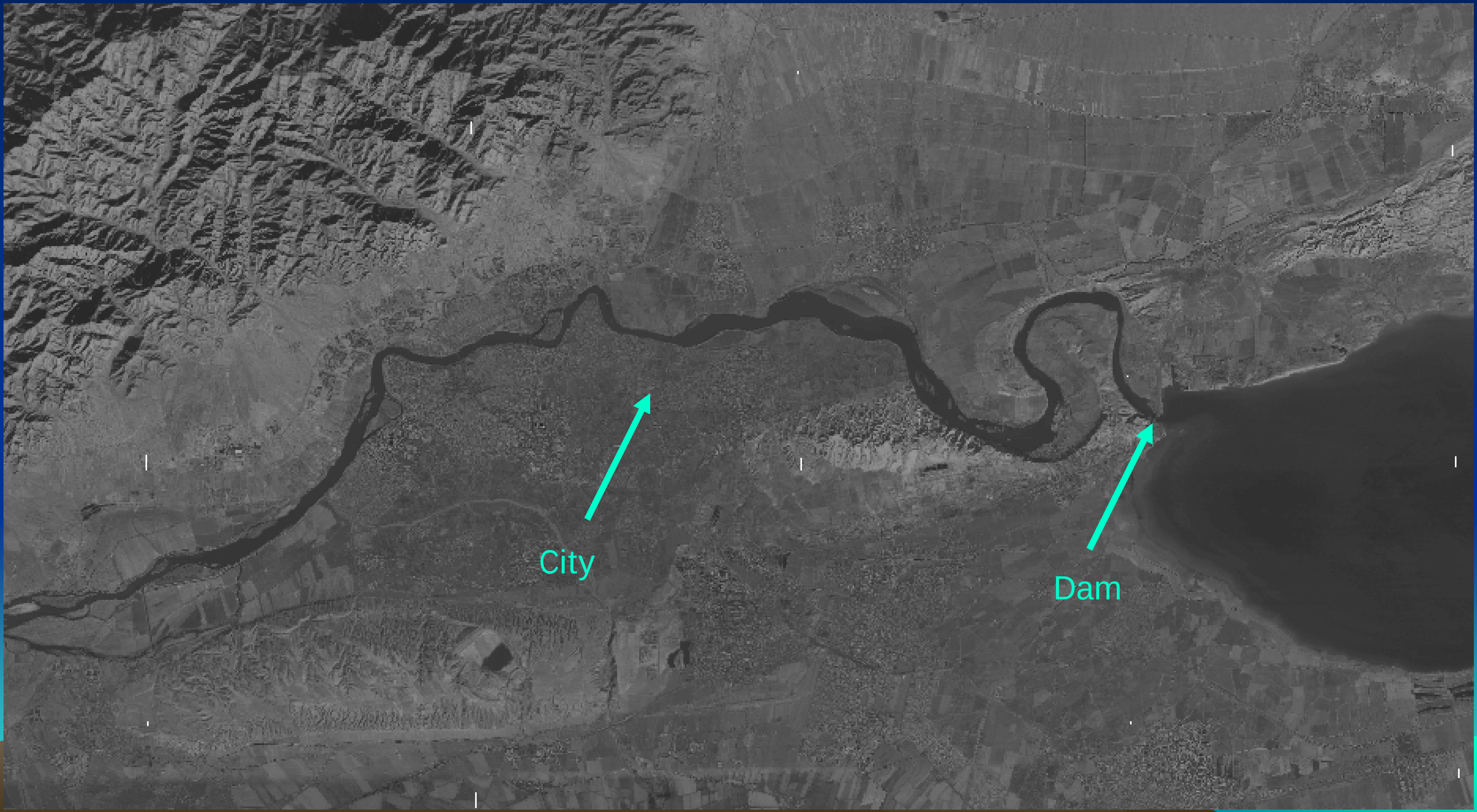
Sample Dam Failure
Teton Dam June 5, 1976

Photos by Mrs. Eunice Olson

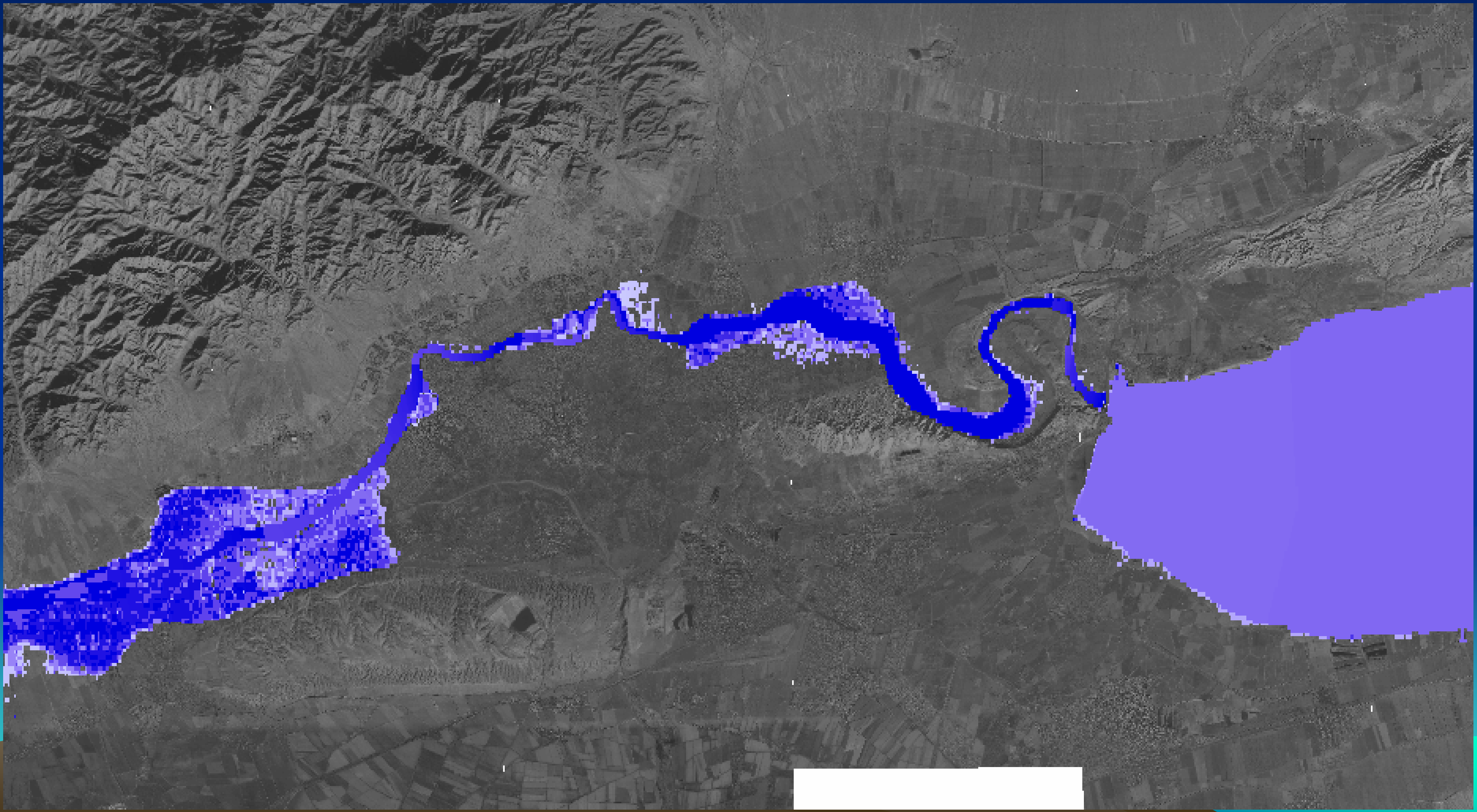
TTX Example - Tajikistan 2004

- Disaster scenario was a large earthquake that caused a dam to fail and flood a city in Tajikistan and then flood Uzbekistan

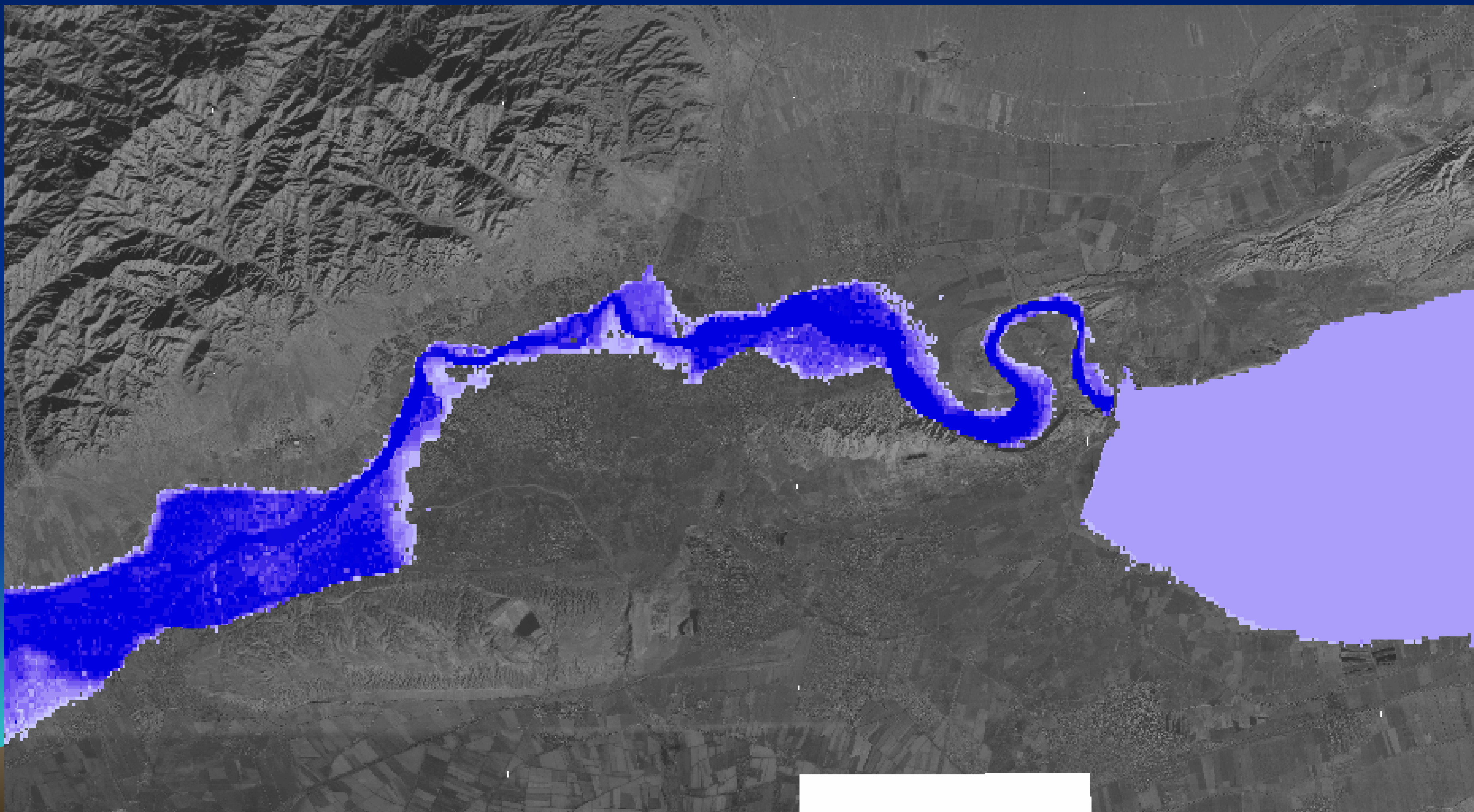
Prior to Dam Failure



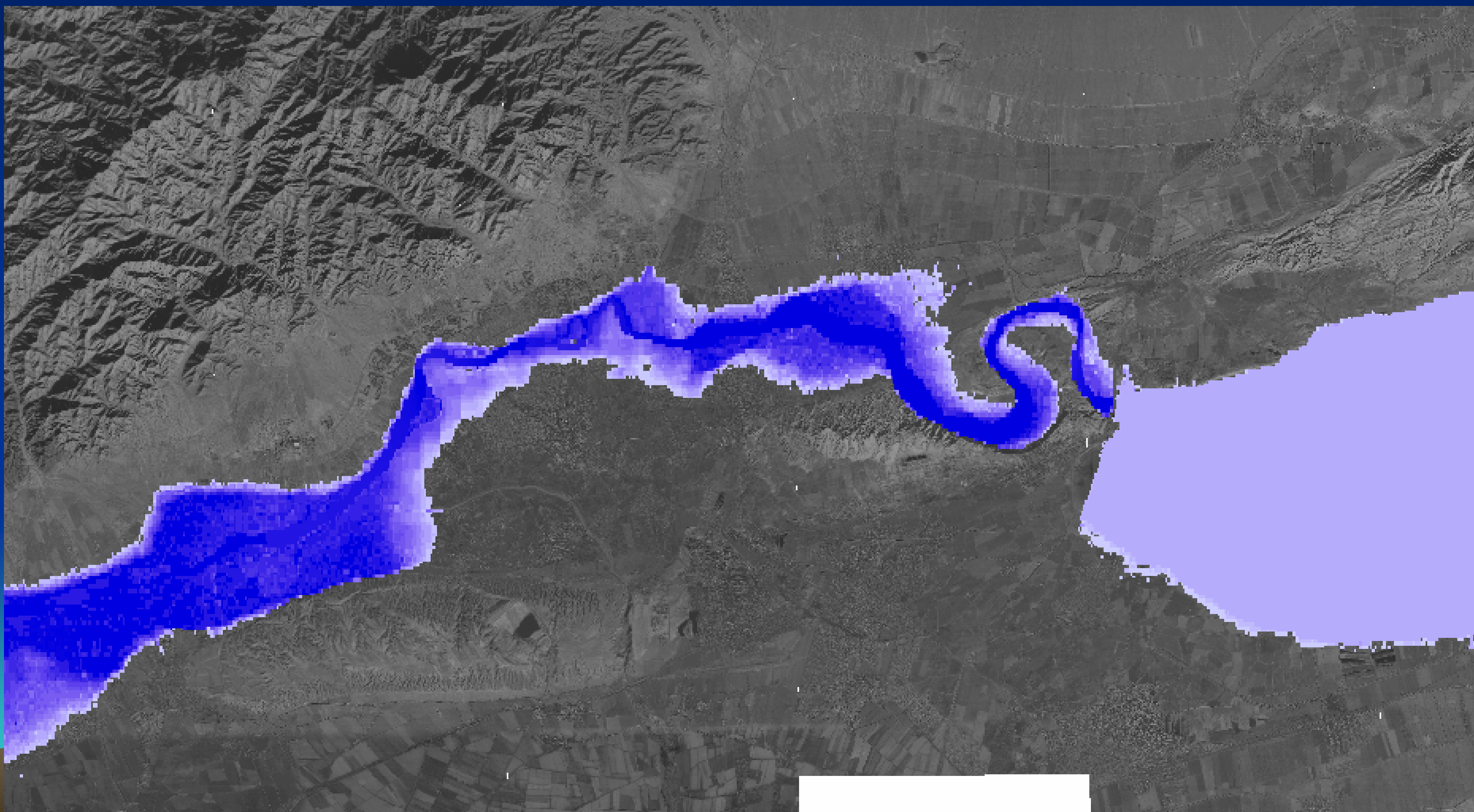
Dam Failure +1 Hour



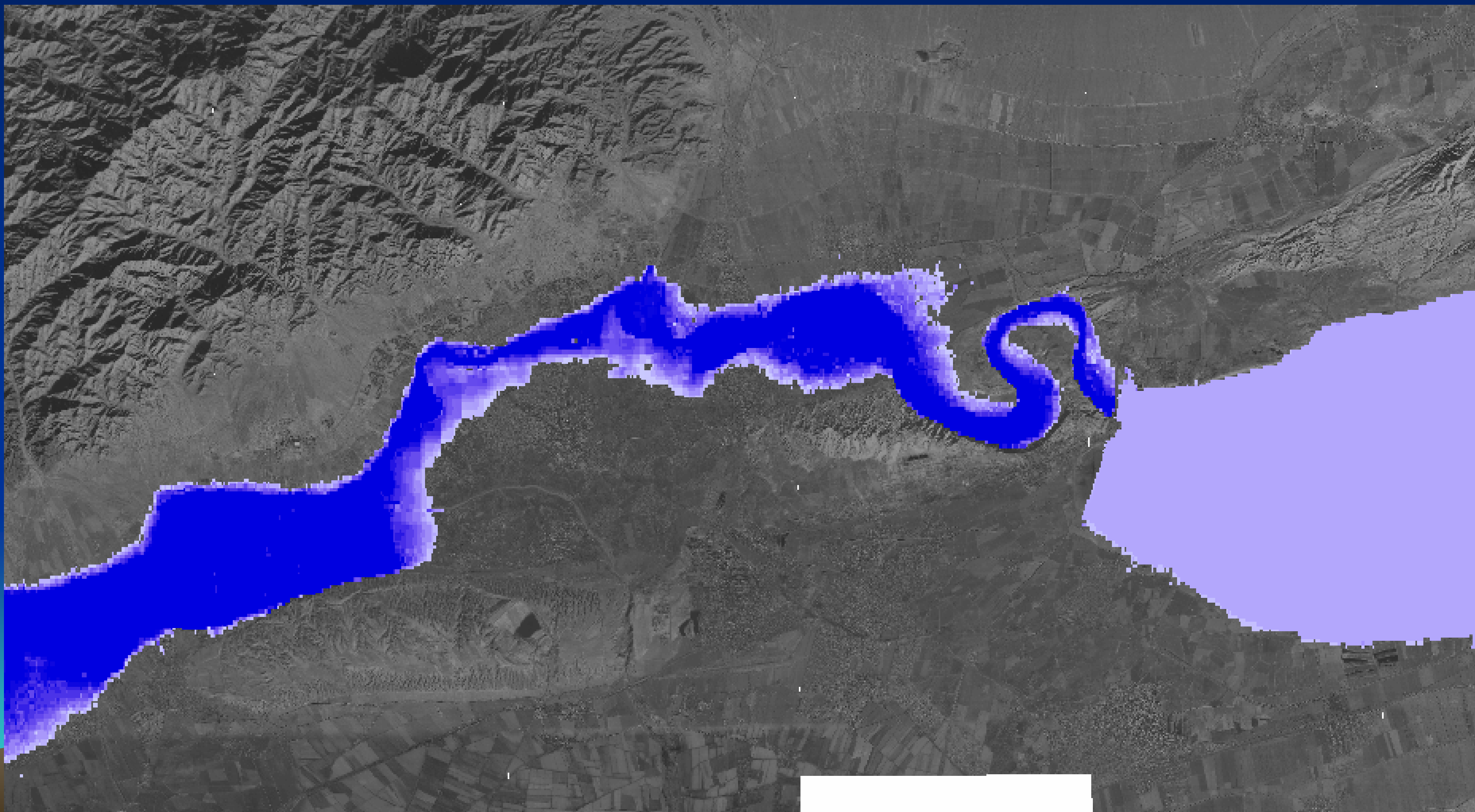
Dam Failure +2 Hours



Dam Failure +4 Hours



Dam Failure +10 Hours



Dam Failure Analysis

- Must be prepared and setup before the event
- Software:
  - GIS Software (ArcView, ArcGIS, …)
  - Dam Breach Capable Hydraulic Analysis Tool (HEC-RAS)
- Skills:
  - GIS
  - Hydraulic Engineering (unsteady flow modeling)
- Effort/Time required for this analysis:
  - Gathering GIS data (images, terrain) ~months
  - Performing hydraulic analysis ~weeks
  - Flood inundation mapping ~weeks

- Total ~2-3 Months

GIS Software

- One license of ArcGIS 9 is provided by CMEP to the host country
- Some Exercises use ArcGIS 8 (and in the case of Bosnia and Herzegovina ArcView 3.x)
- Product licensing fees are a burden on these countries and organizations

Language Barriers

- In most cases English works fine
- In Tajikistan we had simultaneous translation

Security Concerns

- Tajikistan – had security with us at all times and they slept in cots outside our hotel room doors
  - When I coordinated with another GIS facilitator, she said no problem (but I did not know that she was comparing it to Iraq, be sure to get the baseline)
- Sarajevo, BiH – In country brief reported that it is safer than any large city in US, … but here is the number for the Marines
  - don’t call unless needed, apparently they make an entrance.

Cultural Tour

- CMEP exercises include a cultural event

Other Observations

- What does 40% Unemployment look like?
  - Grass was cut by hand
  - Hotel turned back lot to a large vegetable garden
  - Fruit trees instead of ornamental trees

Tajikistan TTX Video

Sediment and Water Quality in HEC-RAS

Mark Jensen

The HEC-RAS Modeling System

- 1D River Hydraulics
- Graphical User Interface
- Steady & Unsteady Flow
- Bridges, Culverts, Dams, weirs, gates, etc…
- Data storage/management
- Graphics, Tabular Output & Reporting
- GeoRas – ArcGIS

History of HEC-RAS Development

- 1D Steady Flow Analysis
  - FY 1992 - 1999
  - Produced Steady flow versions of HEC-RAS (Beta 1&2, Versions 1.0 - 1.2, 2.0 – 2.2)
- 1D Unsteady Modeling for River Analysis
  - FY 2000 – 2005
  - Versions 3.0 – 3.1.3
- 1D Sediment Transport for River Analysis
  - FY 2004 – 2007
- 1D Water Quality Modeling
  - FY 2004 – 2007

Features added to recent versions of HEC-RAS

- Mixed Flow Regime for Unsteady Flow
- Dam Break Analysis
- Levee Breaching
- Pump Stations
- Navigation Dams
- Stable Channel Design and Analysis
- Sediment Transport Potential

New HEC-RAS Developments (that we will be talking about today)

- Sediment Transport (Mobile Bed Hydraulics)
- Water Quality

Mobile Bed Sediment Transport

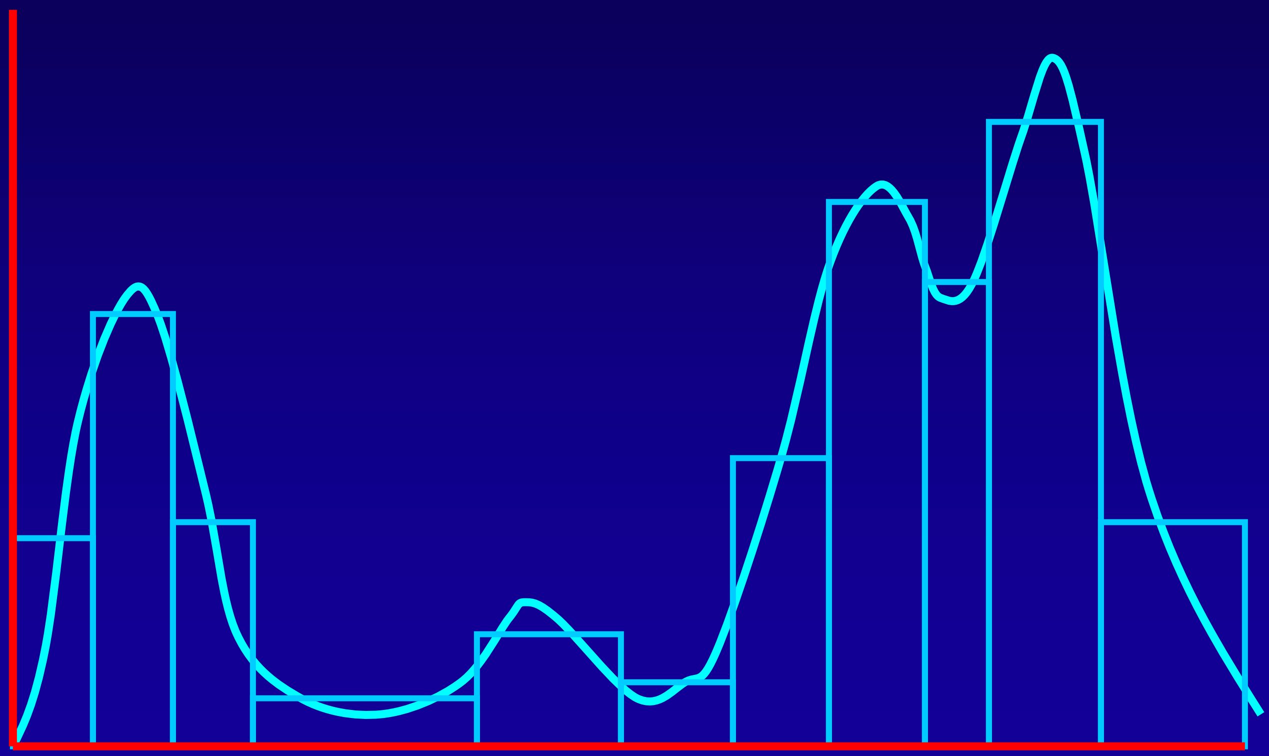
- Goals of adding sediment routing into HEC-RAS
- Quasi-Steady Hydrodynamics
- Transport Capacity
- Sediment continuity
- Sorting and Armoring
- Erosion and Deposition
- User Interface Design
- Preliminary Results
- Additional Capabilities Planned

Goals of adding Mobile Bed Capabilities into HEC-RAS

- Replicate the capabilities of HEC-6
  - Re-coding general capabilities in RAS
  - Differences exist in hydraulic computations
- Add new capabilities beyond current HEC-6 Features
- Improve the capabilities where we have known deficiencies

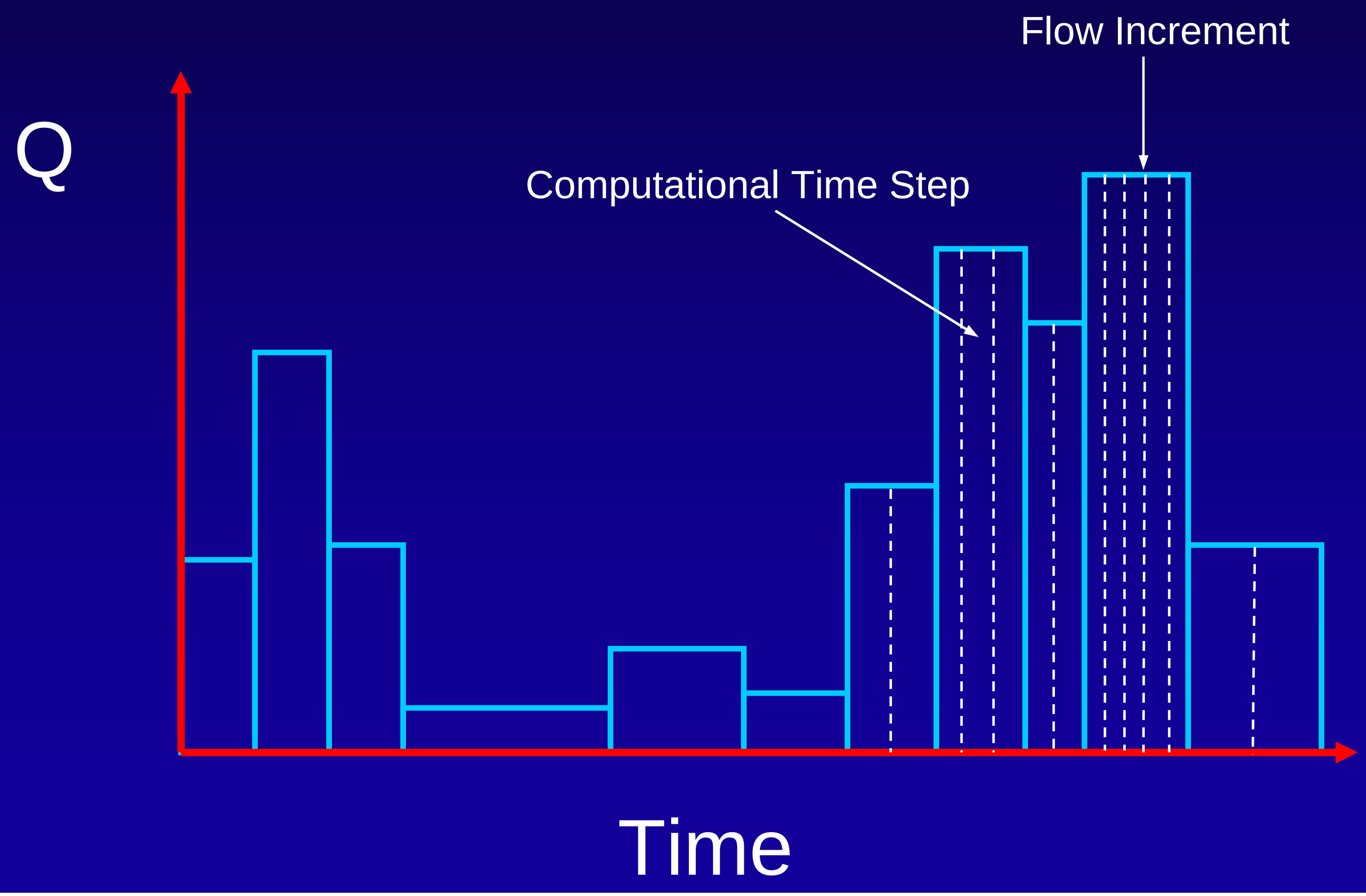
Quasi-Steady Flow

- Flow Hydrograph represented by a series of steady flows associated with durations.



- Requires a new way of handling flows in HEC RAS

Computational Time Steps



Transport Potential Functions

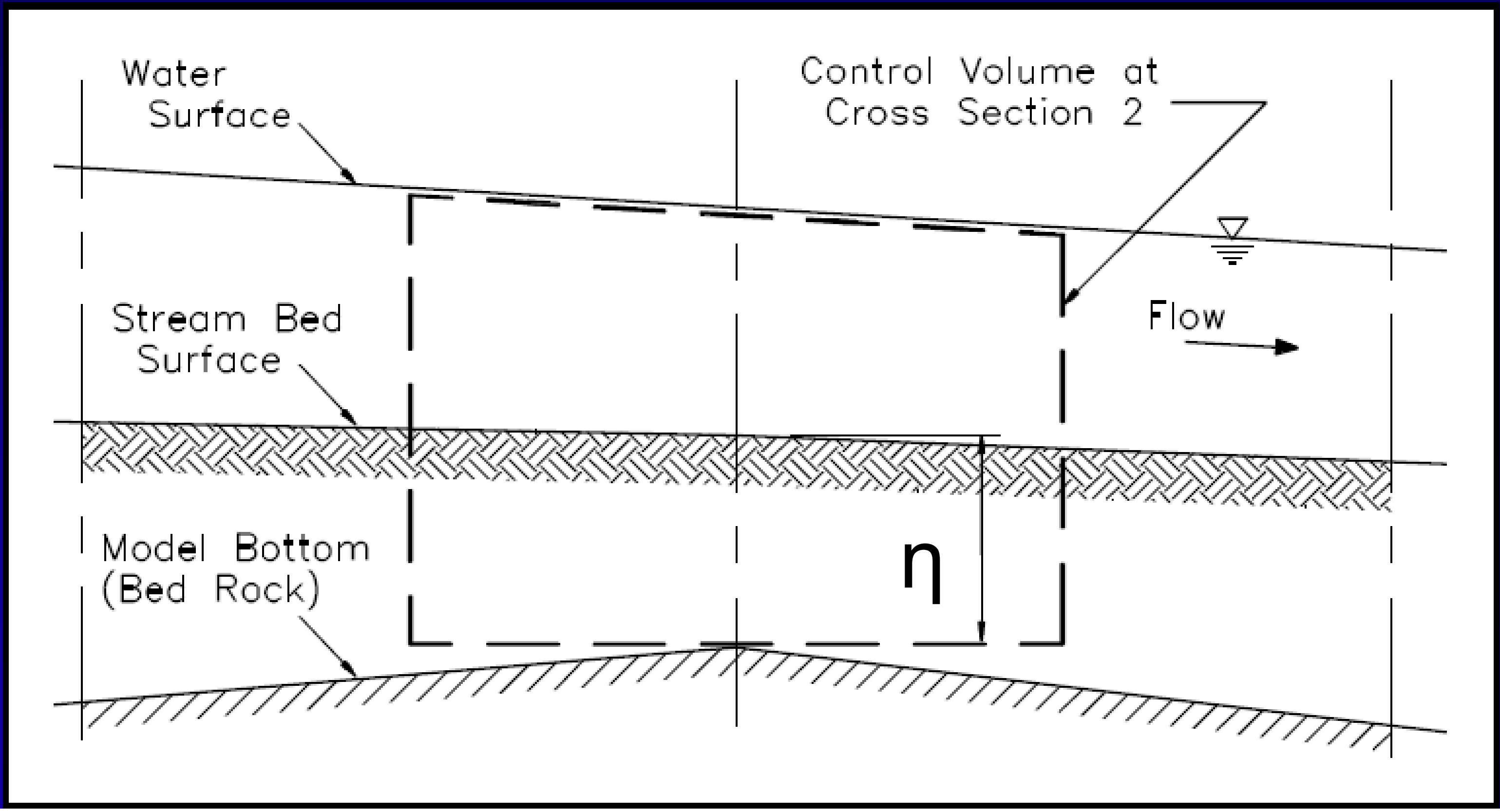
- Ackers-White
- Englund-Hansen
- Laursen (Copeland)
- Myer-Peter-Meuler
- Toffaleti
- Yang (Sand and Gravel)

Transport Capacity

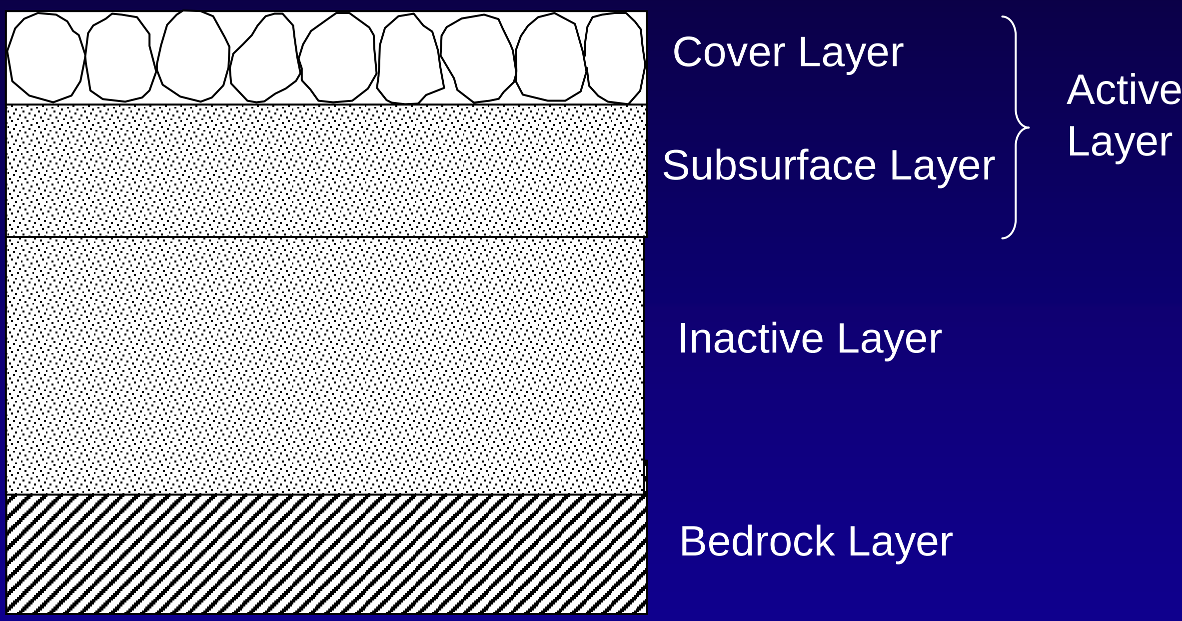
- Bed Material and Inflowing Load divided into separate grain classes (up to 20)
- Transport potential is calculated for each grain size
- Transport Capacity = (Transport Potential for each grain size) X (fraction of that material in active layer of bed)

Sediment Continuity: Exner Equation

$$(1-\lambda_p)B\frac{\partial \eta}{\partial t} = -\frac{\partial Q_s}{\partial x}$$



Sorting and Armoring



Diagramed and Conceptualized HEC 6 Code

3 Methods in HEC-6T

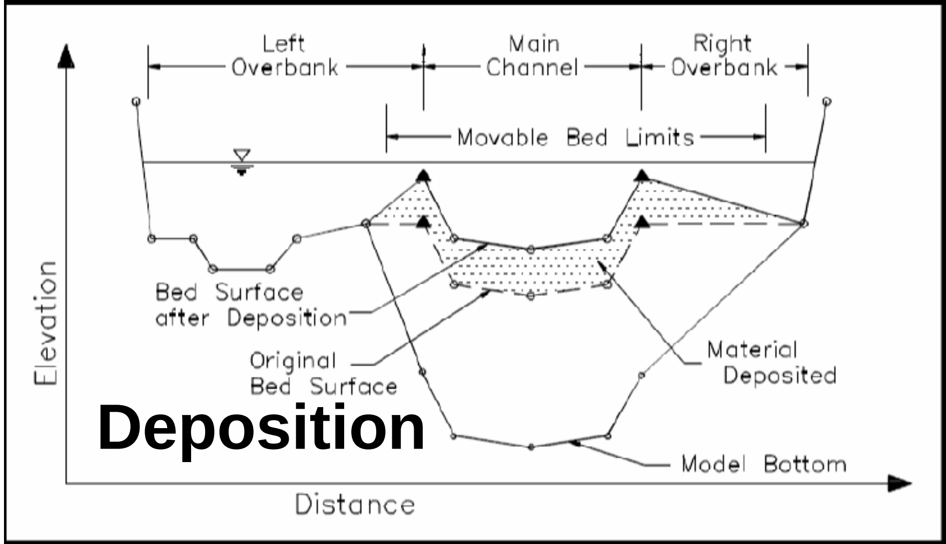
Exner 5 implemented Currently in RAS

Temporal Constraints on Eroding and Depositing

- Erosion and deposition does not occur instantaneously.
- Deposition is based on settling velocity:
  - Deposition efficiency coefficient = $\dfrac{V_s(i)\cdot \Delta t}{D_e(i)}$
- Erosion is based on "Characteristic Flow Length"
  - Erosion = (Gs – Qs) x C_e Entrainment Coefficient
  - Where:

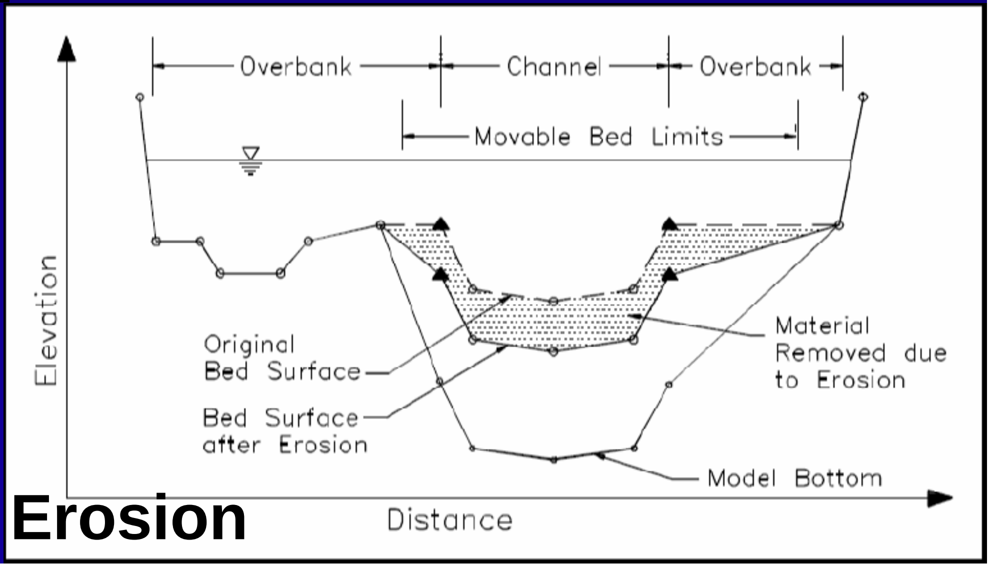
$$C_e = 1.368 - e^{\frac{L}{30 \cdot D}}$$

Erosion and Deposition to RAS Cross Sections



RAS computations modified to compute bed changes and modify cross sections before each time step

- **Cross Sections**
- **Bridges**



Sediment User Interface

Sediment Data

File Options View Help

Initial Conditions and Transport Parameters | Boundary Conditions

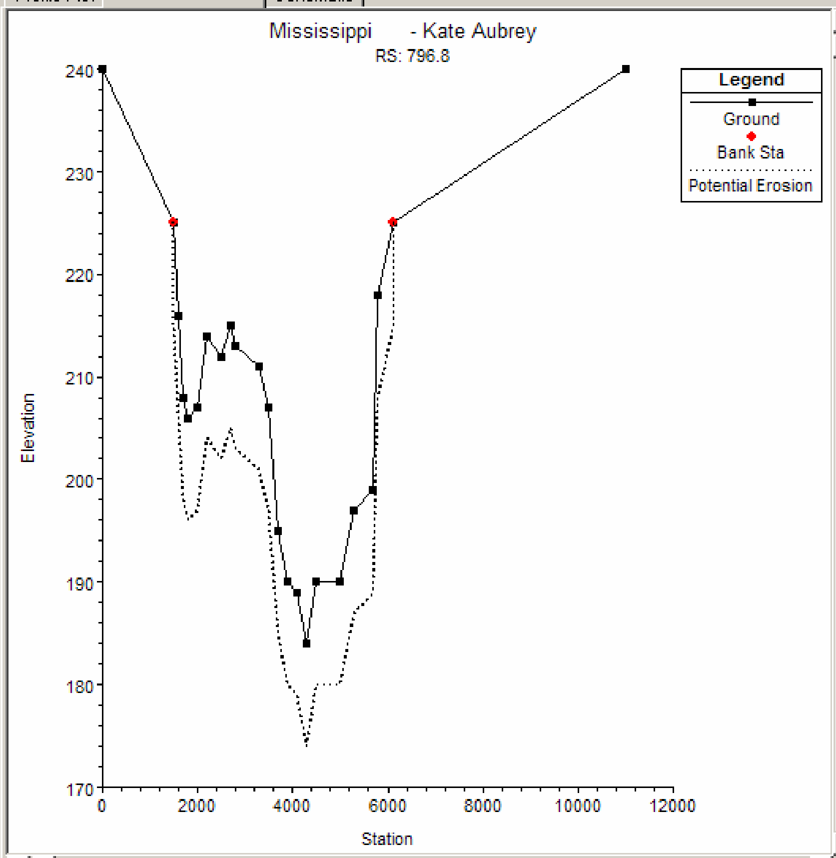
River: (All Rivers) Transport Function: Ackers-White Define/Edit Bed Gradation ...

Reach: Sorting Method: Exner 5

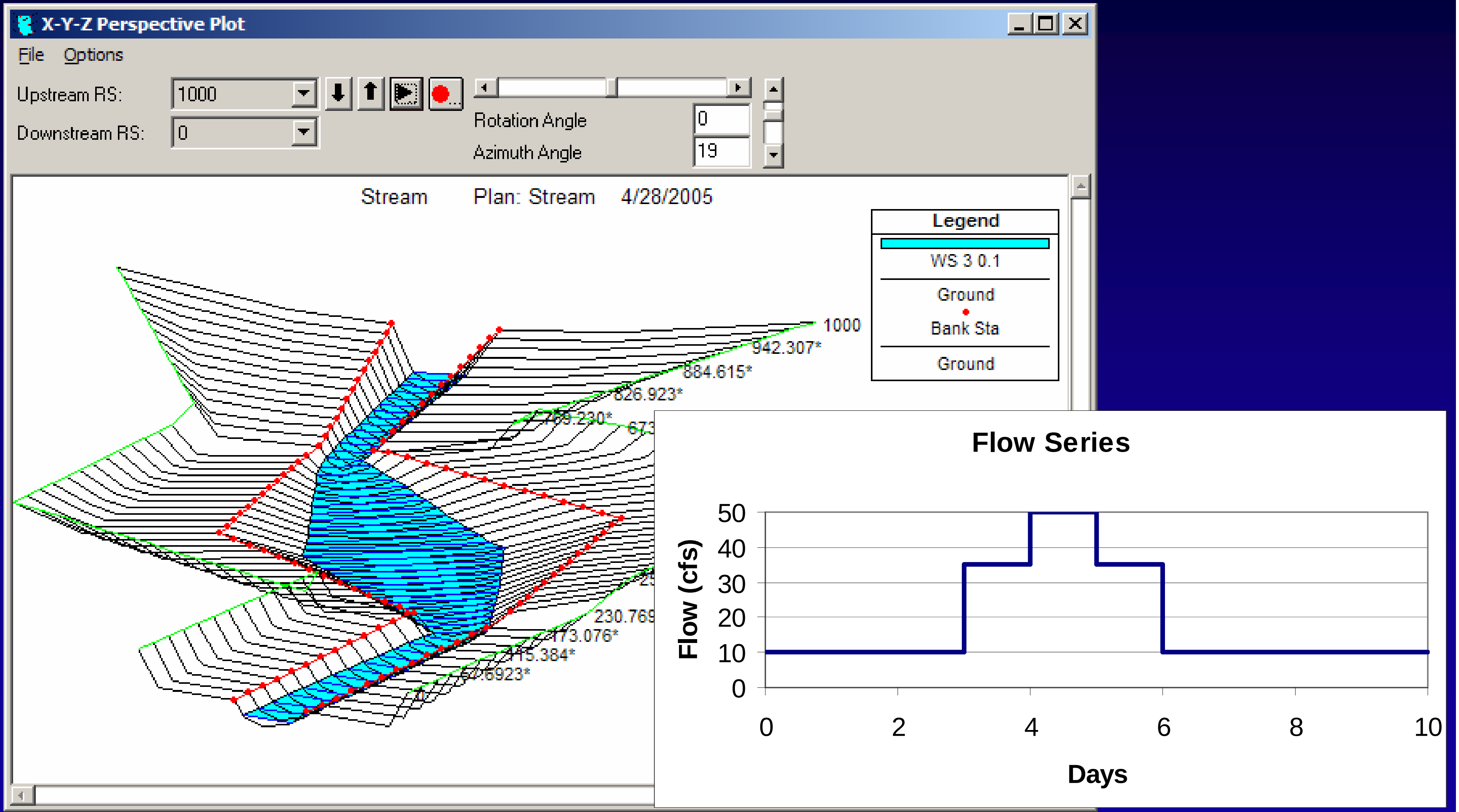
Use Banks

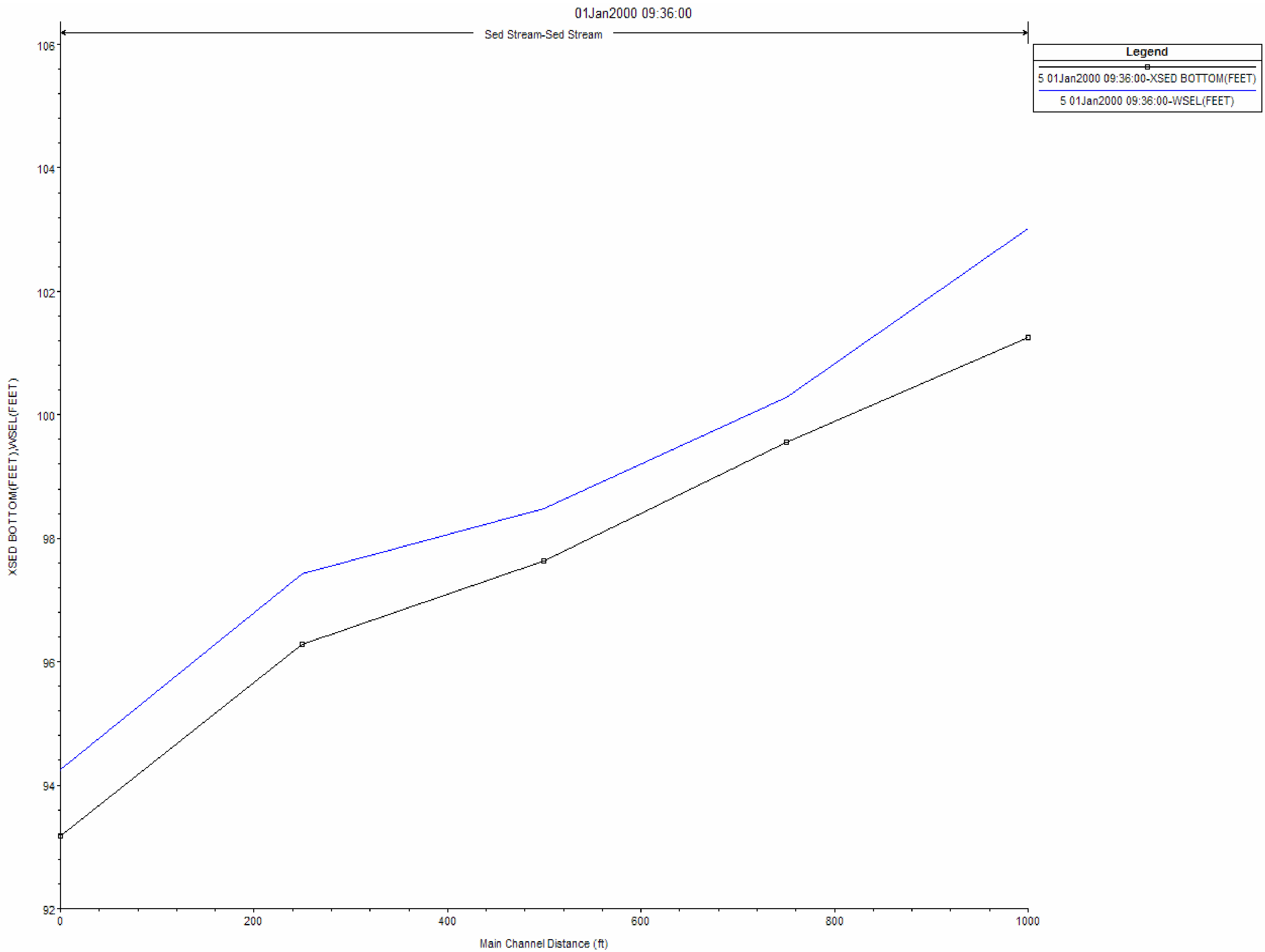
	River	Reach	RS	Invert	Max Depth	Min Elev	Sta Left	Sta Right	Bed Gradation
1	Mississippi	Kate Aubrey	806.6	182	10	0	900	5500	Gravel
2	Mississippi	Kate Aubrey	805.8*	174.6	10	0	1080	5740	Gravel
3	Mississippi	Kate Aubrey	805.*	167.2	10	0	1260	5980	Gravel
4	Mississippi	Kate Aubrey	804.2*	159.8	10	0	1440	6220	Gravel
5	Mississippi	Kate Aubrey	803.4*	152.4	10	0	1620	6460	Gravel
6	Mississippi	Kate Aubrey	802.6	145	10	0	1800	6700	Fine Sand
7	Mississippi	Kate Aubrey	801.771*	150.57	10	0	1757.14	6614.29	Fine Sand
8	Mississippi	Kate Aubrey	800.942*	156.14	10	0	1714.29	6528.57	Fine Sand
9	Mississippi	Kate Aubrey	800.114*	161.71	10	0	1671.43	6442.86	Fine Sand
10	Mississippi	Kate Aubrey	799.285*	167.29	10	0	1628.57	6357.14	Fine Sand
11	Mississippi	Kate Aubrey	798.457*	172.86	10	0	1585.71	6271.43	Fine Sand
12	Mississippi	Kate Aubrey	797.628*	178.43	10	0	1542.86	6185.71	Fine Sand
13	Mississippi	Kate Aubrey	796.8	184	10	0	1500	6100	Fine Sand
14	Mississippi	Kate Aubrey	795.887*	184.75	10	0	1537.5	6287.5	Fine Sand
15	Mississippi	Kate Aubrey	794.975*	185.5	10	0	1575	6475	Coarse Sand
16	Mississippi	Kate Aubrey	794.062*	186.25	10	0	1612.5	6662.5	Coarse Sand
17	Mississippi	Kate Aubrey	793.15*	187	10	0	1650	6850	Coarse Sand
18	Mississippi	Kate Aubrey	792.237*	187.75	10	0	1687.5	7037.5	Coarse Sand
19	Mississippi	Kate Aubrey	791.325*	188.5	10	0	1725	7225	Coarse Sand
20	Mississippi	Kate Aubrey	790.412*	189.25	10	0	1762.5	7412.5	Coarse Sand
21	Mississippi	Kate Aubrey	789.5	190	10	0	1800	7600	Coarse Sand
22	Mississippi	Kate Aubrey	788.716*	187.33	10	0	1983.33	7683.33	Coarse Sand
23	Mississippi	Kate Aubrey	787.933*	184.67	10	0	2166.67	7766.67	Coarse Sand
24	Mississippi	Kate Aubrey	787.15*	182	10	0	2350	7850	Coarse Sand
25	Mississippi	Kate Aubrey	786.366*	179.33	10	0	2533.33	7933.33	Fine Sand
26	Mississippi	Kate Aubrey	785.583*	176.67	10	0	2716.67	8016.67	Fine Sand
27	Mississippi	Kate Aubrey	784.8	174	10	0	2900	8100	Fine Sand
28	Mississippi	Kate Aubrey	784.04*	173.8	10	0	2780	7800	Fine Sand
29	Mississippi	Kate Aubrey	783.28*	173.6	10	0	2660	7500	Fine Sand

Profile Plot | Cross Section Plot | Schematic



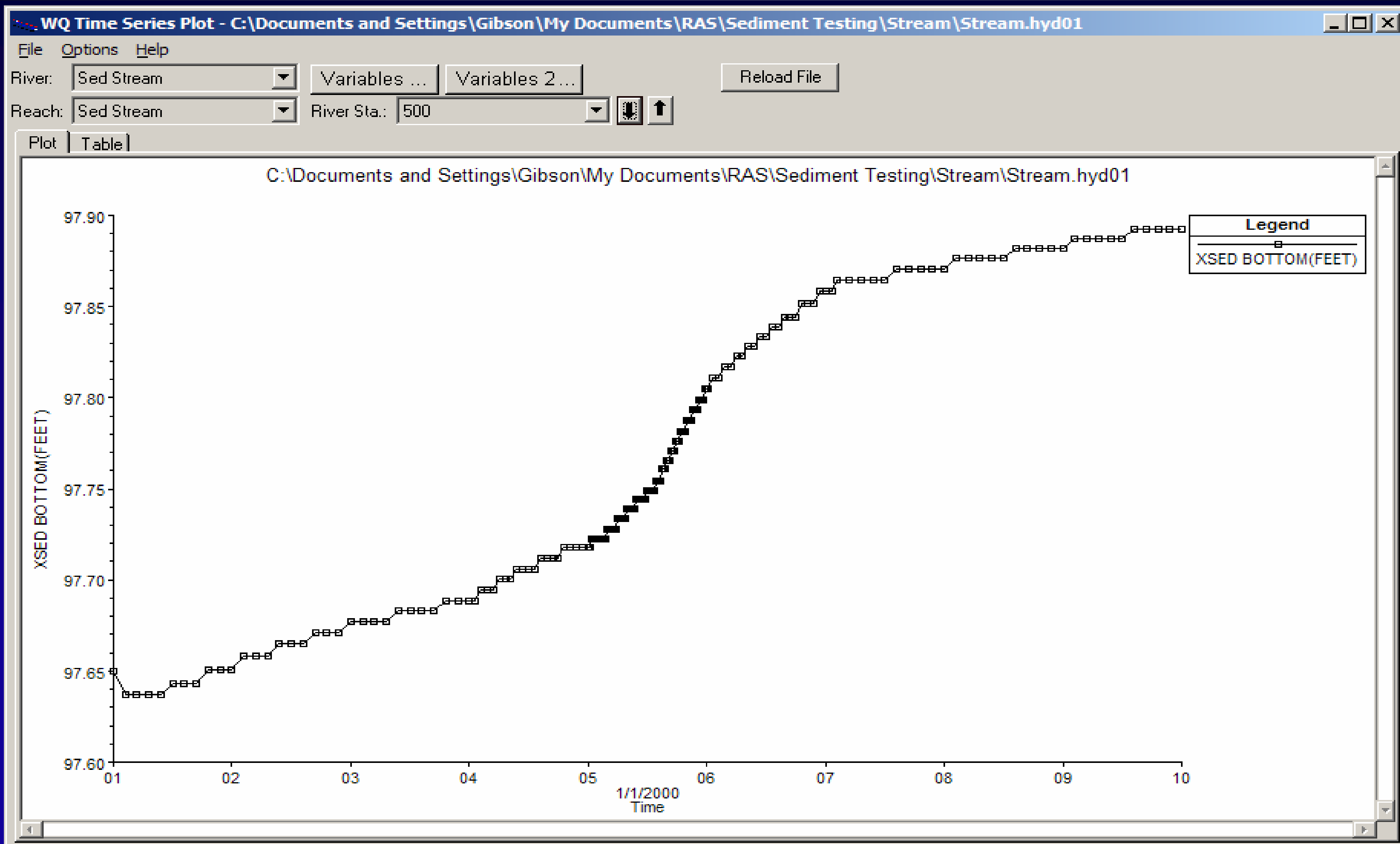
Simple Transport Example





01Jan2000 09:36:00
Sed Stream-Sed Stream
Legend
5 01Jan2000 09:36:00-XSED BOTTOM(FEET)
5 01Jan2000 09:36:00-WSEL(FEET)
XSED BOTTOM(FEET),WSEL(FEET)
106
104
102
100
98
96
94
92
0
200
400
600
800
1000
Main Channel Distance (ft)

Time Series of Bed Elevation at a Single XS

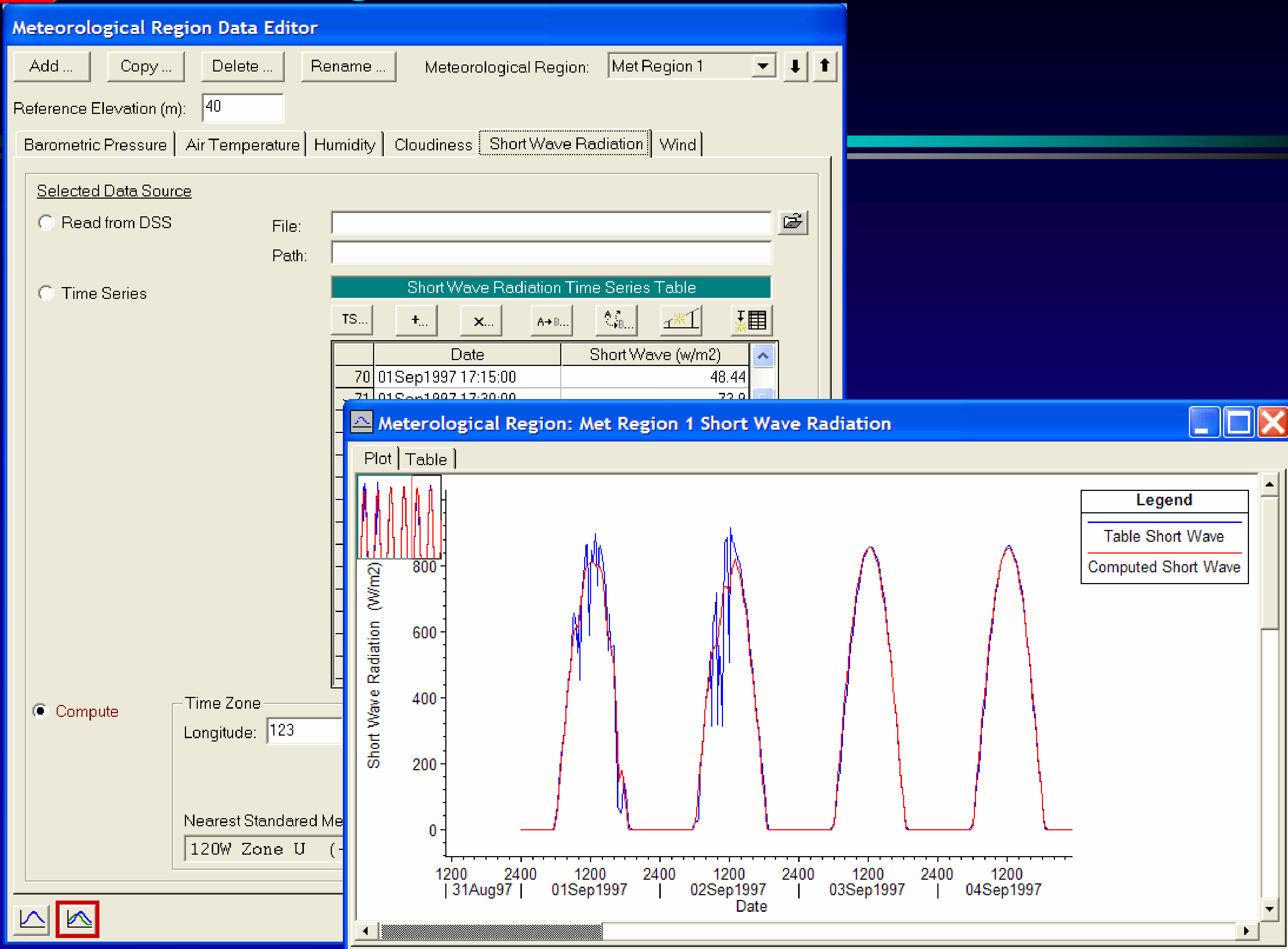


Water Quality

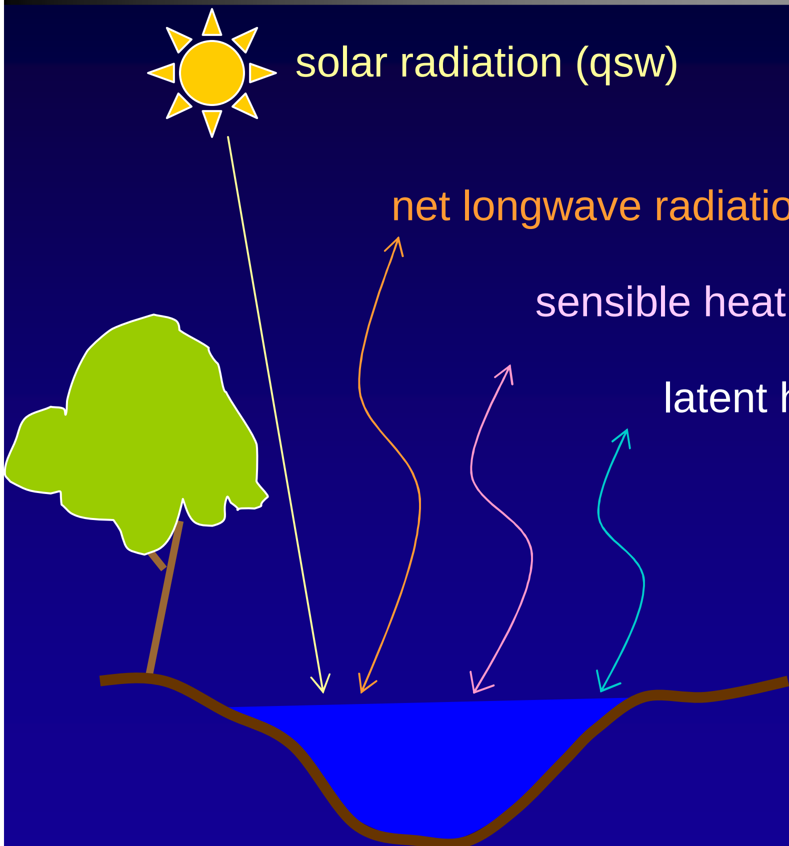
Water Quality (Temperature) Model

- Based on unreleased version of CE-QUAL-RIV1
- QUICKEST-ULTIMATE numerical scheme
  - Finite Volume
  - Variable grid size
  - Automatic time step selection
- Full energy budget for Temperature
- Working with ERDC to use a common Nutrient Model

Meteorological Data Editor – Solar Radiation



Source/Sink Term for Temperature (Energy Budget)



solar radiation (qsw) — f (site location, time of day, day of year, atmospheric turbidity, cloud cover)

net longwave radiation (qlw) — f (air temperature, water temperature)

sensible heat (qh) — f (temperature gradient, wind, a&b)

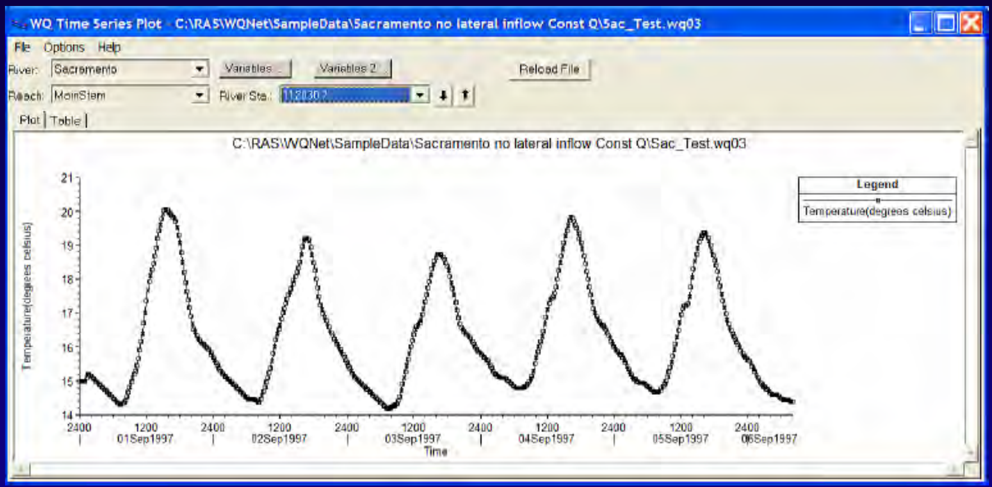
latent heat (qe) — f (vapor pressure gradient, wind, a&b)

$$q_{net} = q_{sw} + q_{lwn} + q_h + q_e$$

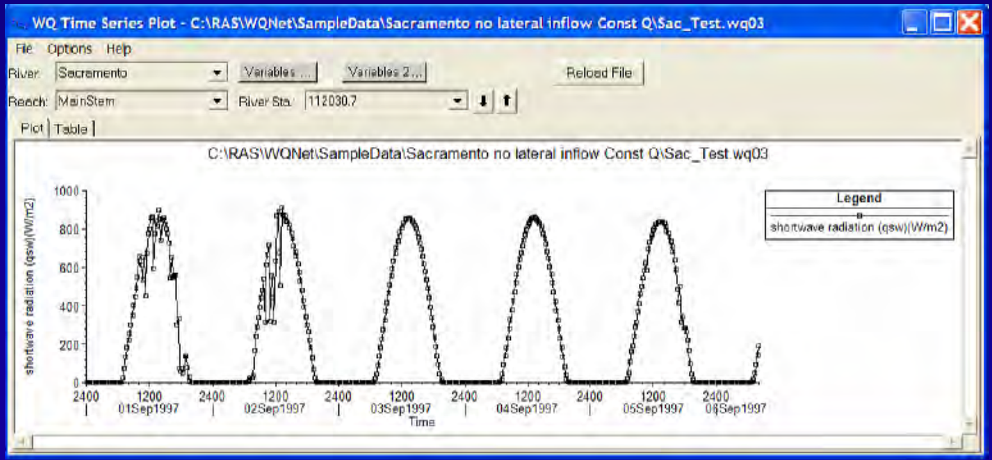
Planned:

- ground heat conduction
- shading (topographic, riparian)

Time Series Plots

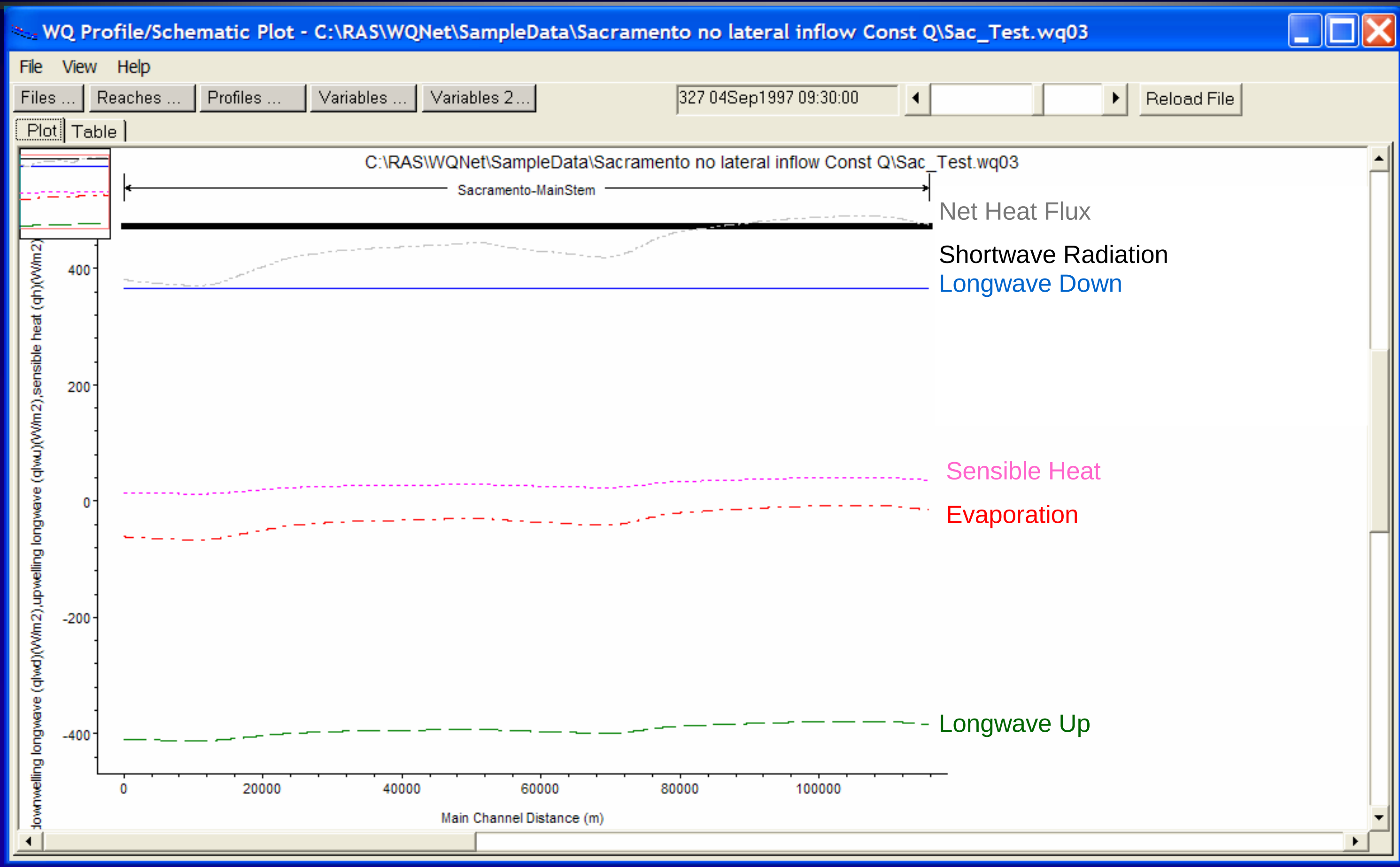


Water temperature



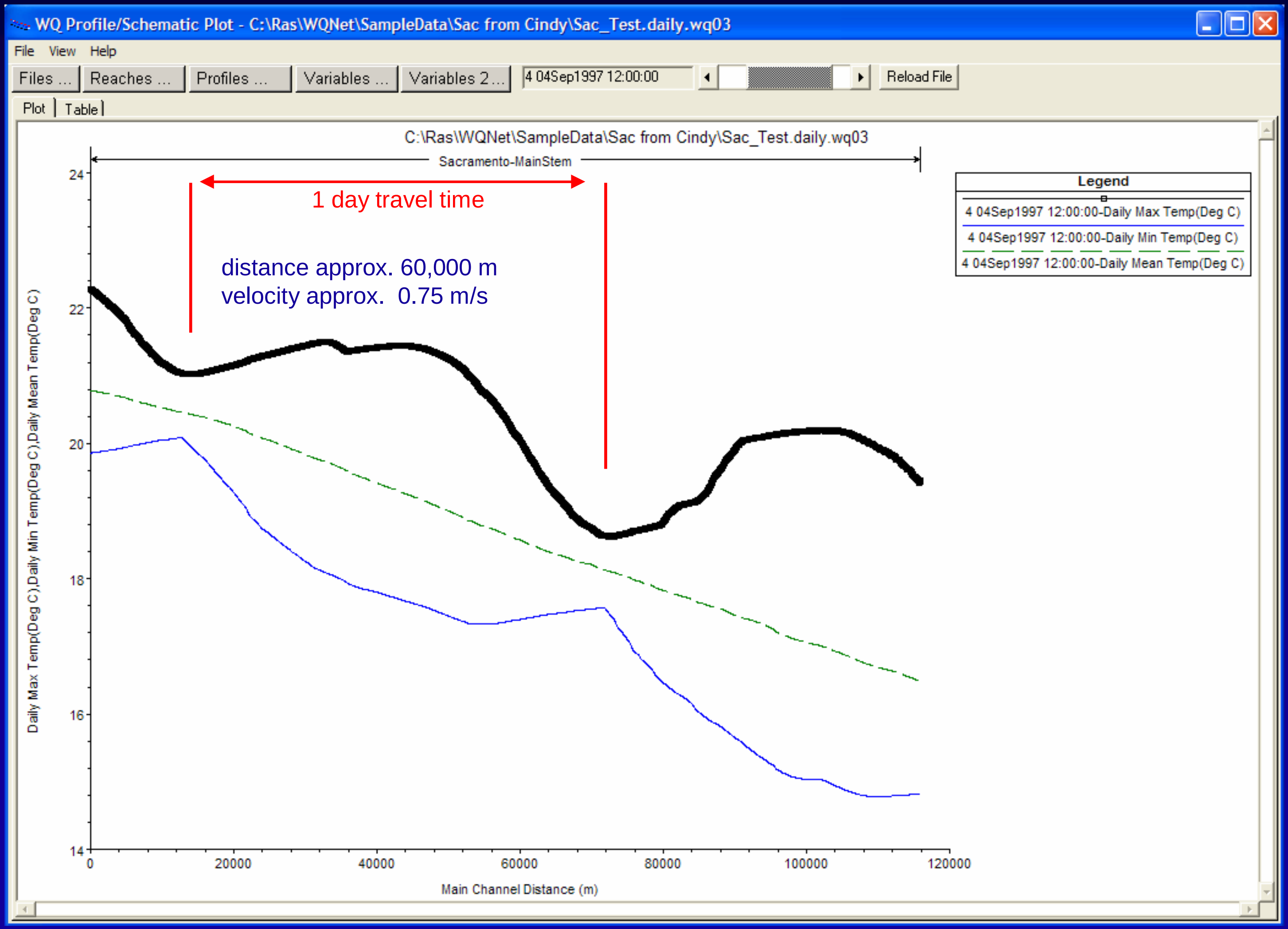
Solar Radiation

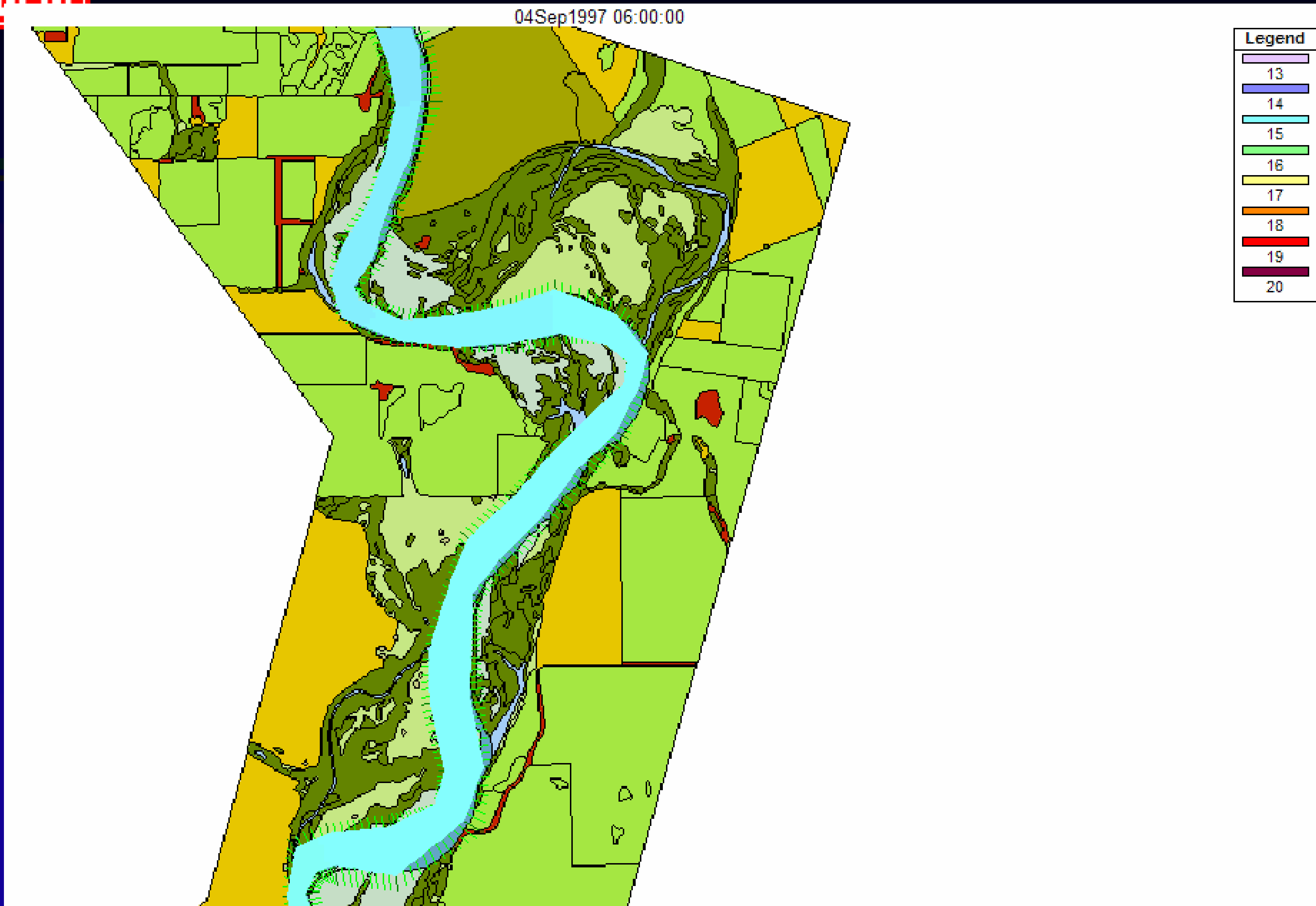
Plot of Energy Budget Terms



Component Outputs can be Viewed Separately

Profile Plot of Temperature

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Legend
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Demonstration Program
Urban Flooding and Channel Restoration
in Arid and Semi-Arid Regions (UFDP)

Program Overview and Direction

US Army Corps of Engineers

ERDC
Engineer Research and Development Center

Points of Contact

- Joan Pope, ERDC
- Jack Davis, CHL Technical Directors Office
- Ed Sing, SPD, Executive Committee
- John Warwick, Desert Research Institute
- Meg Jonas, ERDC-CHL, Program Manager
- contact at:
- margaret.m.jonas@erdc.usace.army.mil

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Program Overview

- FY05 funding of $2M ($1.6M after S&S)
- Collaboration between Corps and Desert Research Institute ($1.1M+ to DRI).
- Urban flood and channel restoration demonstration program
- Congressional add ($2M) in FY03 by Sen. Reid (NV) FY04 funding of $1M ($650k after S&S). Envisioned as 5-year program with $2-3 million funding per year
- Regional program adapted for arid and semi-arid regions
- Products must be useful to the field
- Teaming of ERDC, HEC, DRI, SPD, and local interests (SNWA, CCRFCD, Reno, NVDEP, et al)

Program Focus on Arid Regions

- Rapidly developing population centers
- Unique watershed management issues
- Opportunity to meet the special needs of this region
- Expertise of Desert Research Institute
- National mission and expertise of Corps
- Expertise and interest of local stakeholders
- International application for arid regions expertise
- Broad applications for urban channel restoration
- High potential ROI benefits

Urban Flood Damage Reduction

- Supercritical Flood Channels
- Stabilization Measures
- Multi-dimensional Sediment Transport Modeling
- Hydrologic Prediction
- Stability Analyses
- Evaluation of Impacts
- Vegetative Resistance
- Vegetation Stability

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Channel Restoration

- Low-Flow Design
- In-stream Features
- Losses at Bends
- Vegetation Impacts
- Stabilization Measures
- Riparian Restoration
- Stability Analyses
- Habitat Assessment
- Floodplain Restoration
- Water Quality
- Sediment Transport
- Impacts/Benefits Analysis

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Criteria for Work Units

- Demonstration. Take new or nearly completed R&D technologies and demonstrate them in the field. (Not reimbursable work, and not basic research either.)
- High value to field and stakeholders. Priorities identified by SPD and local interests. Field needs are the driving factor. Front-burner issues.
- Quick results (ideally as part of a longer-term strategy)
- High benefit-cost ratio
- Wide application
- Productivity
- Collaboration
- Focus on Corps study sites

Funded work units

- Analytical tools for stream restoration design – Truckee River (sediment modeling)
- Sediment transport processes in arid regions
- Improved design guidance for grade control and bank stabilization in arid regions (Las Vegas Wash)
- Extension of design guidance for supercritical flow channels (Las Vegas)
- Characterization of resistance for southwestern vegetative complexes
- Delineation of arid and semi-arid regions of US
- Technology transfer (including web site)

Funded work units - continued

- QPF – use of high-resolution data to improve estimates
- Spatial variations in alluvial fan materials and runoff characteristics
- Improved infiltration estimates for alluvial fan materials
- Temperature impacts on infiltration (will be incorporated into HEC-HMS in FY06 if program is funded)
- Impact of grade controls on nutrient and metals in sediment (Las Vegas Wash)

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Funded work units - continued

- Truckee River restoration: collaborative effort using habitat mapping (DRI), hydrodynamic modeling (ERDC), and EFM (HEC)
- Truckee River restoration: geomorphic evaluation, hydrologic modeling, and water quality analyses
- 2D sediment transport modeling of Las Vegas Wash – evaluation of channel modifications on downstream flows and sediment transport
- Development of sediment transport function for Las Vegas Wash (bed load and suspended sediment)
- Infiltration - intercode comparison of GSSHA and HEC-HMS (Arizona); development of infiltration algorithm for sloping ground

Arid and semi-arid region delineation for United States

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Truckee River restoration
McCarran Ranch

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Truckee River Channel Restoration

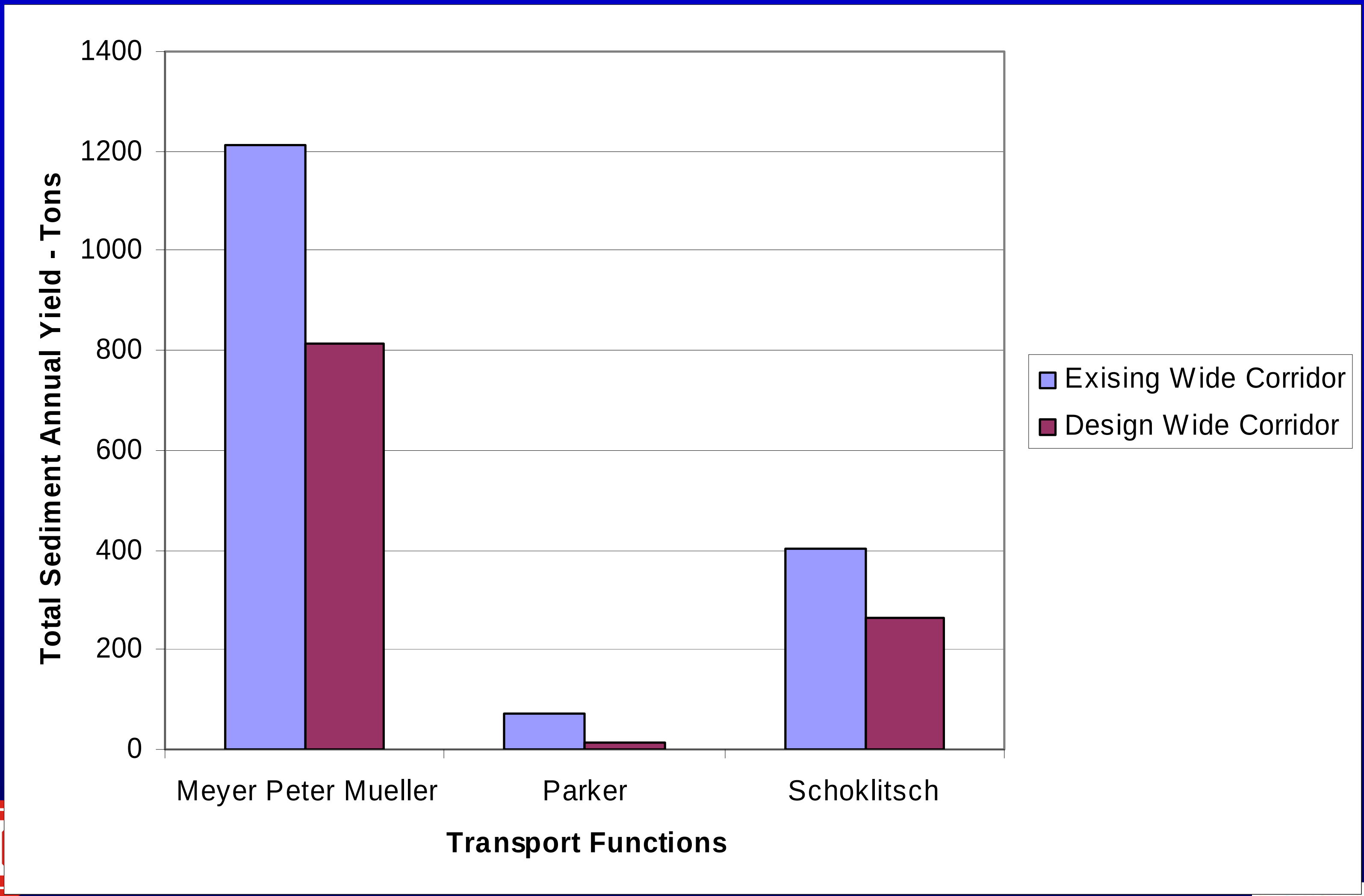
Reconnaissance Level Channel Stability Analysis
Using ERDC SAM Computer Programs

RESTORATION GOALS:

- Restore meandering plan form to the channel

- Modify channel geometry to encourage over bank flooding for a one – two year return flow

Sediment Annual Yield – Wide Channel Corridor



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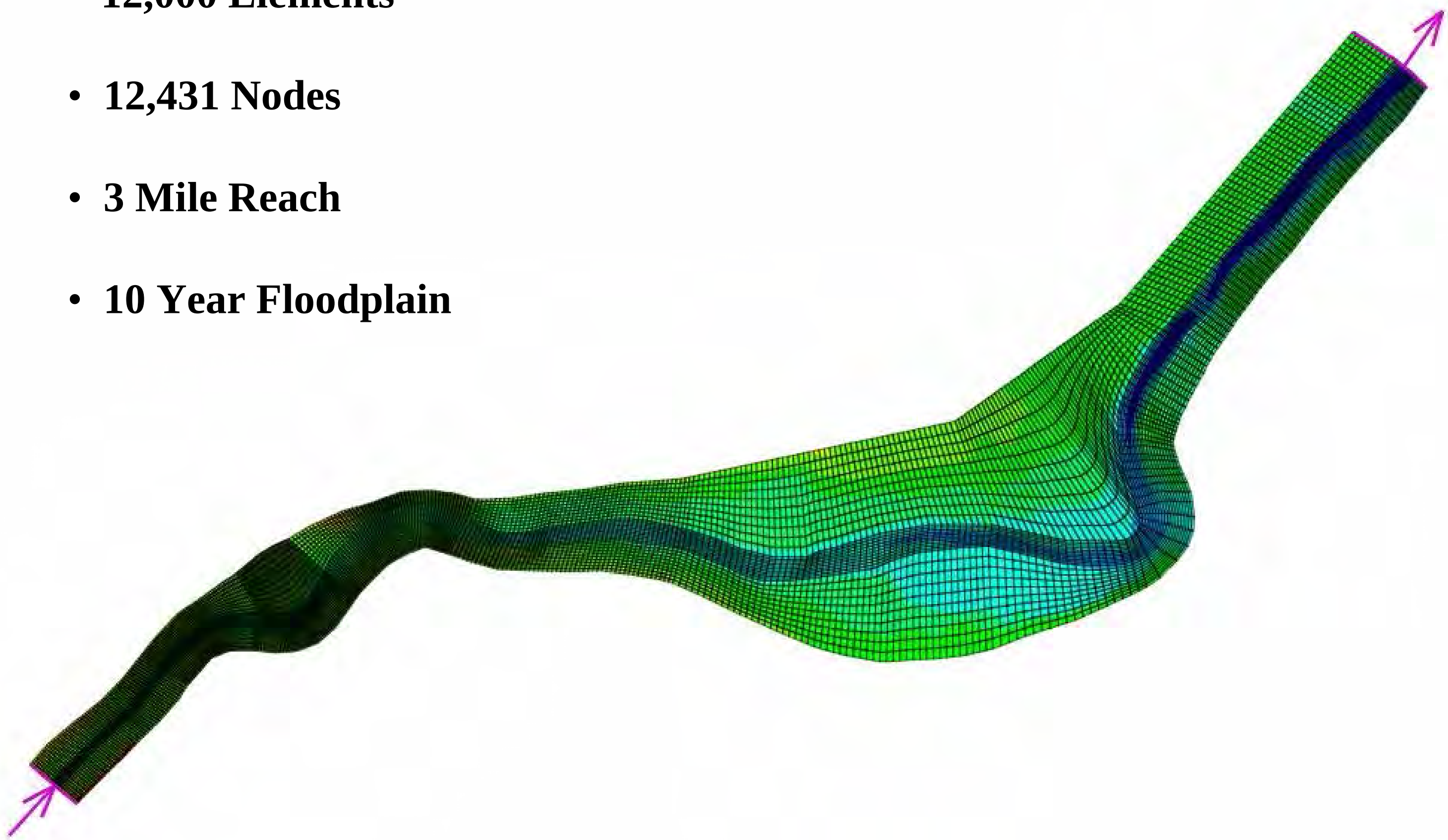
2D Model Finite Element Mesh of Truckee River Restoration Reach

- **12,000 Elements**
- **12,431 Nodes**
- **3 Mile Reach**
- **10 Year Floodplain**



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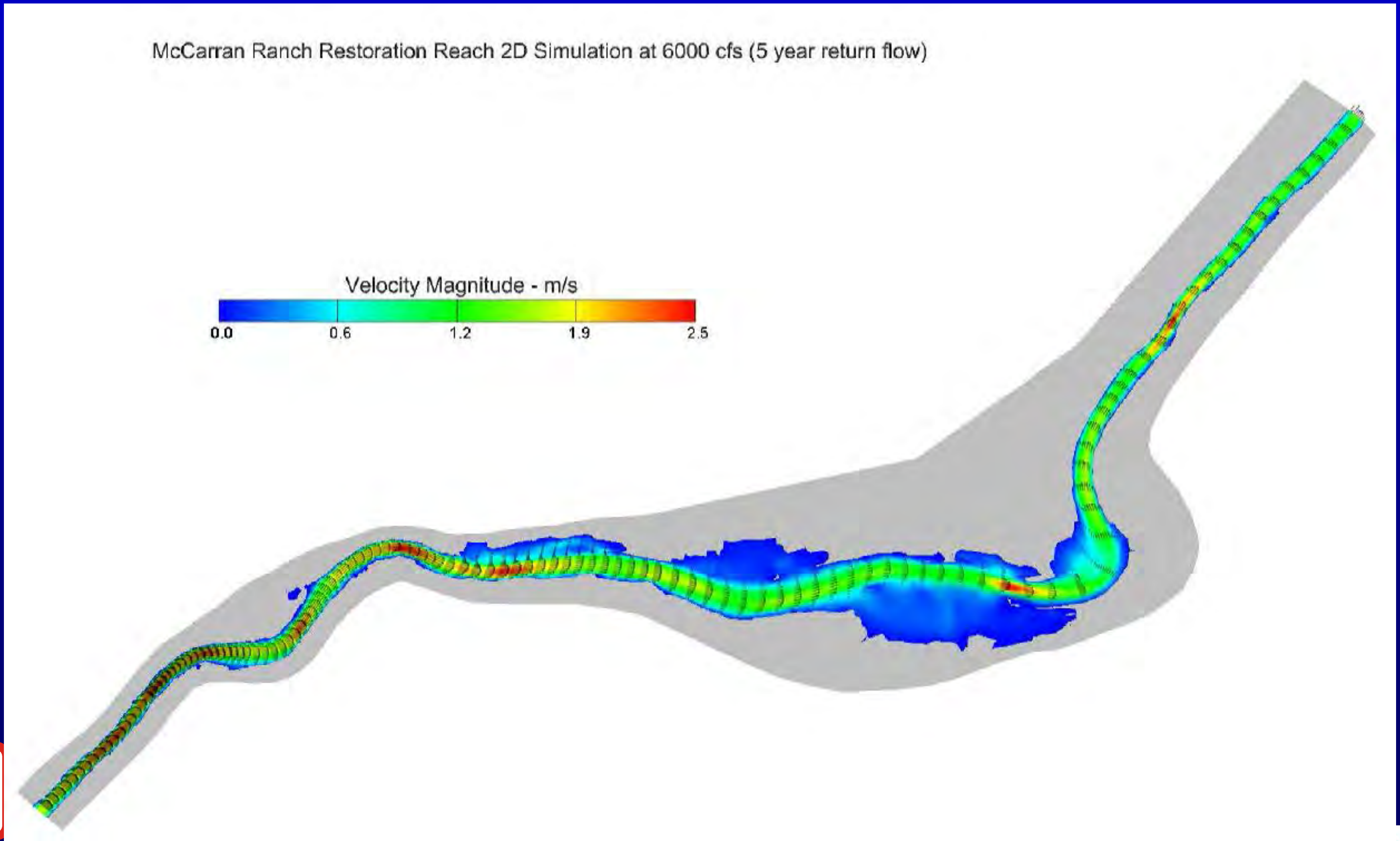
2D Simulation of Existing Over bank Flooding Threshold

Velocity Magnitude



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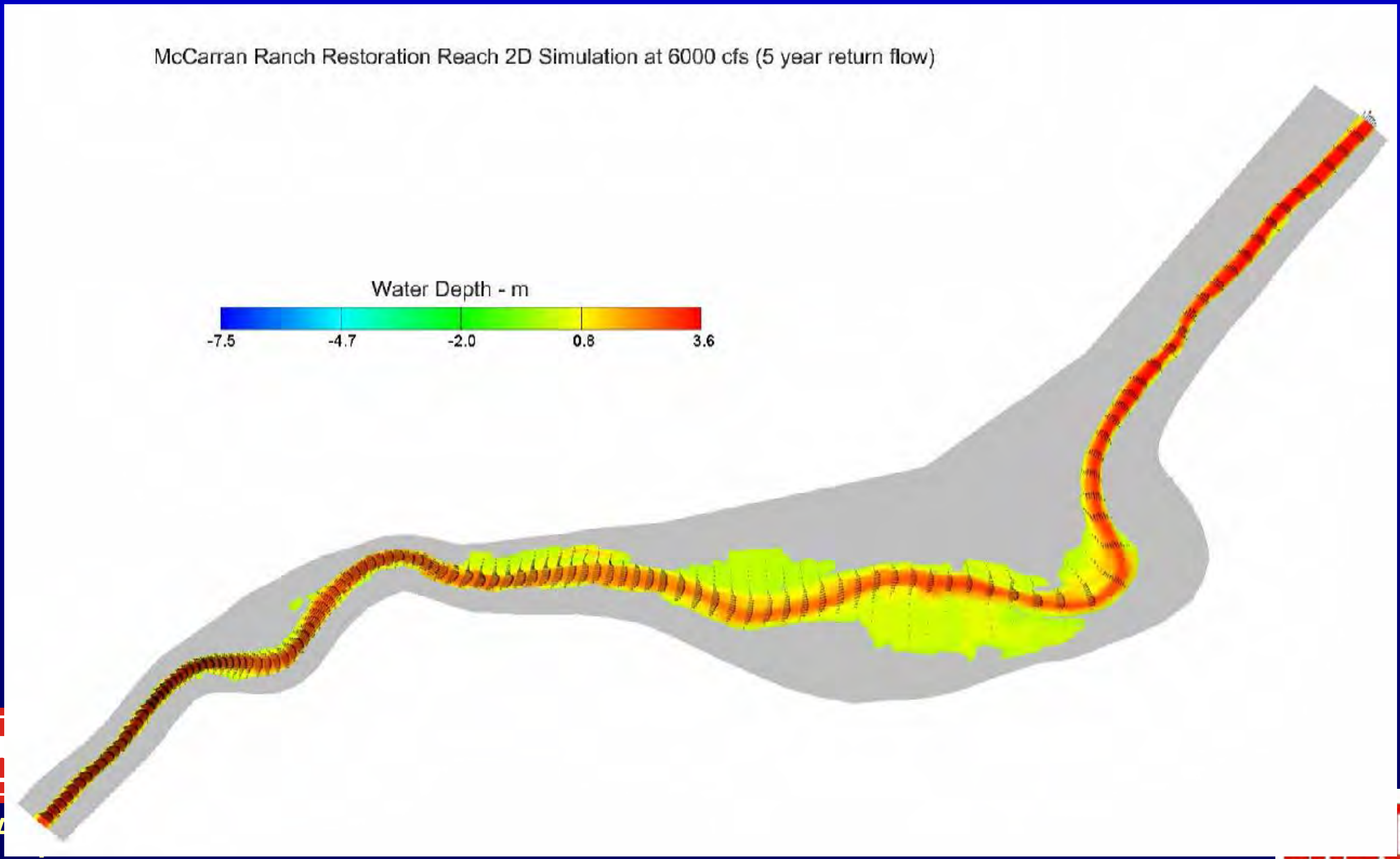
2D Simulation of Existing Over bank Flooding Threshold

Water Depth



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Truckee River Channel Restoration

Goal is to merge 2D hydraulic modeling (ERDC-CHL) with habitat mapping (performed by DRI).

The EFM model developed by HEC will be used to link the hydraulic parameters to the habitat data.

Truckee River
Ecosystem Function Modeling (HEC)
Baetis predicted habitat

River section at McCarran Ranch

Habitat Predictors

Substrate
> 0.5cm

Water column Velocity
> 70 cm/s

Water Depth
> 60 cm

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Supercritical flood channels: extension of design guidance

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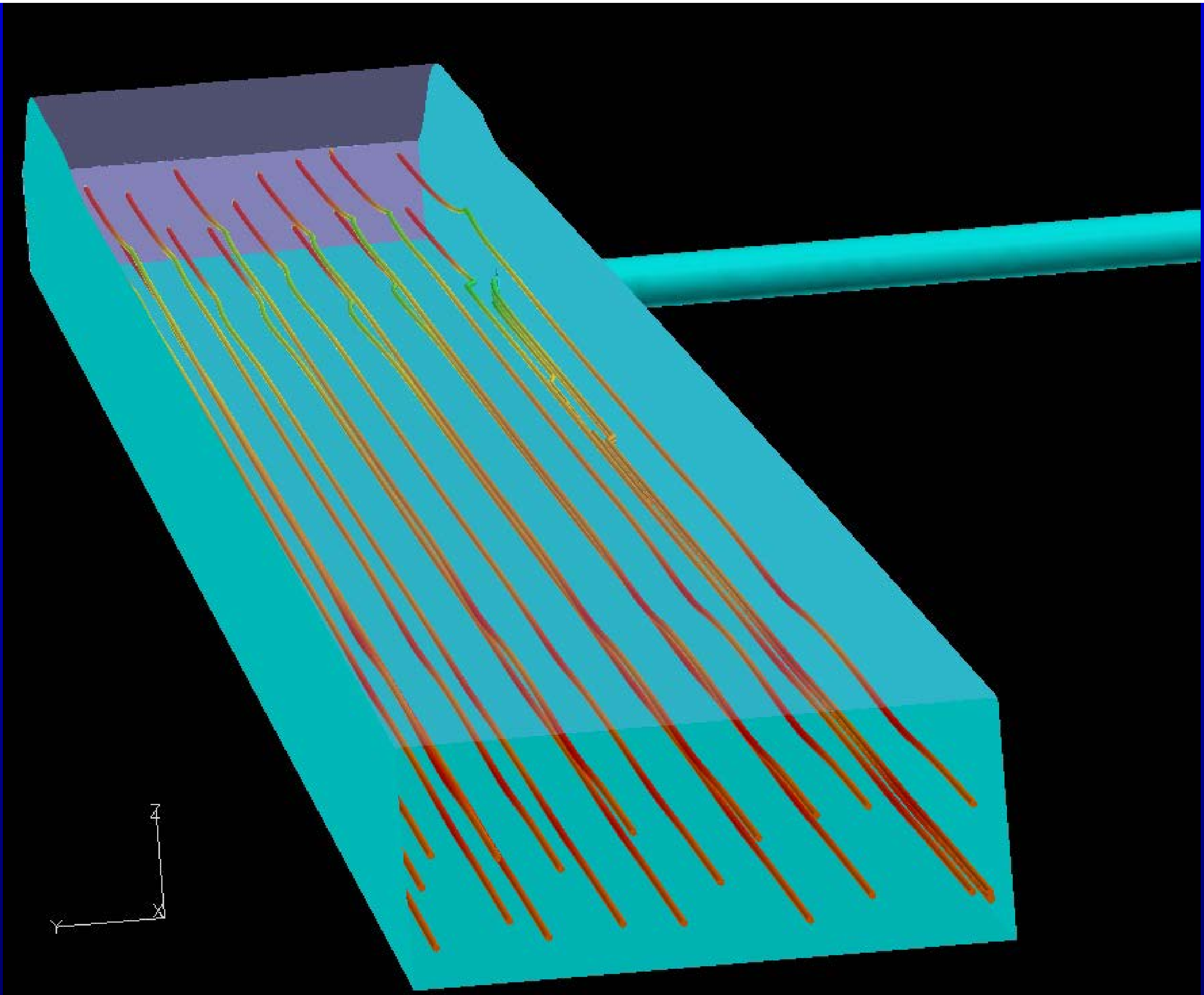

Streamlines Computed with 3D Navier-Stokes Model – Note Lateral Inflow

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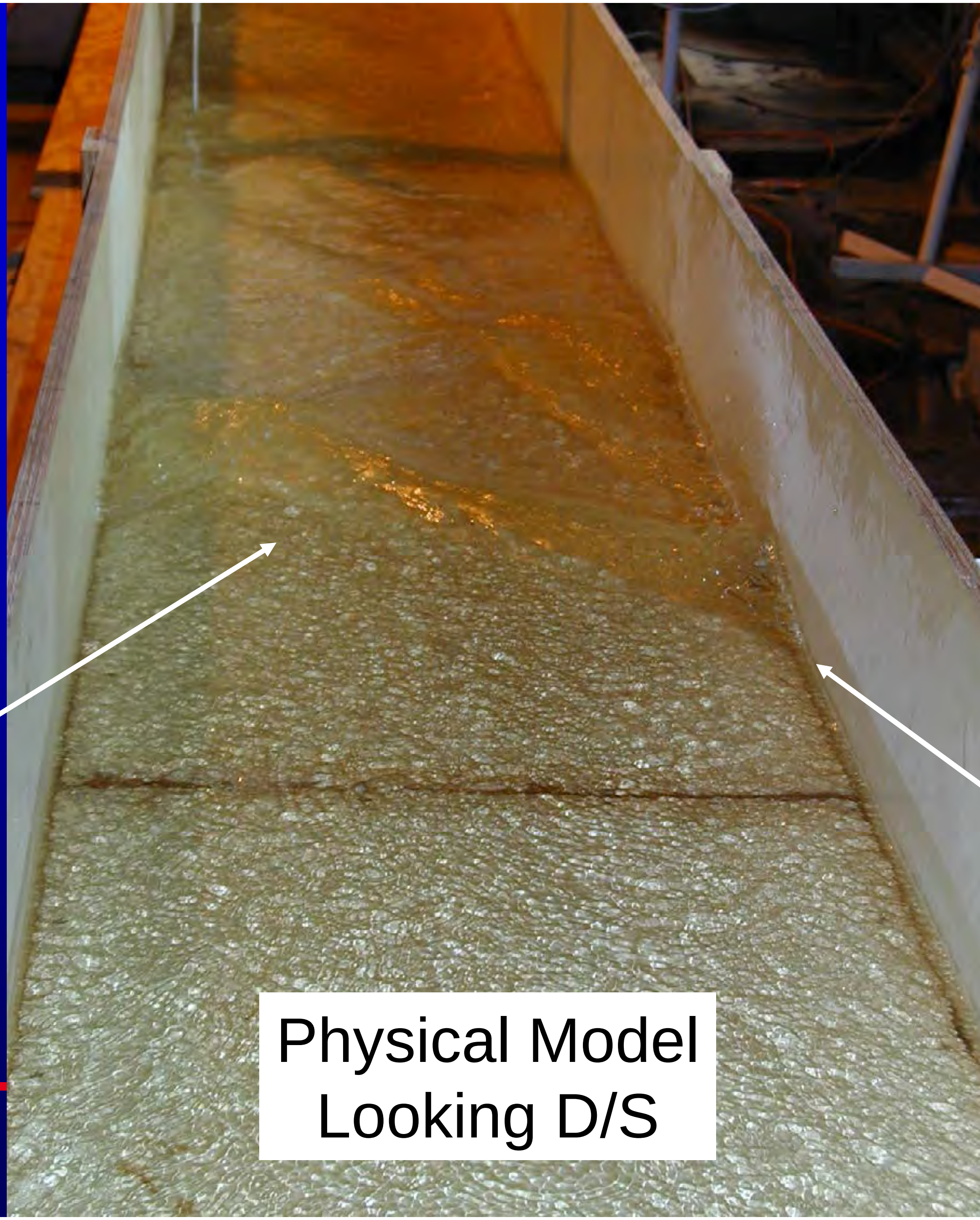
Undular Jump

Lateral Pipe



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Grade control in Las Vegas Wash Improved Design Criteria

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Grade control in Las Vegas Wash Improved Design Criteria

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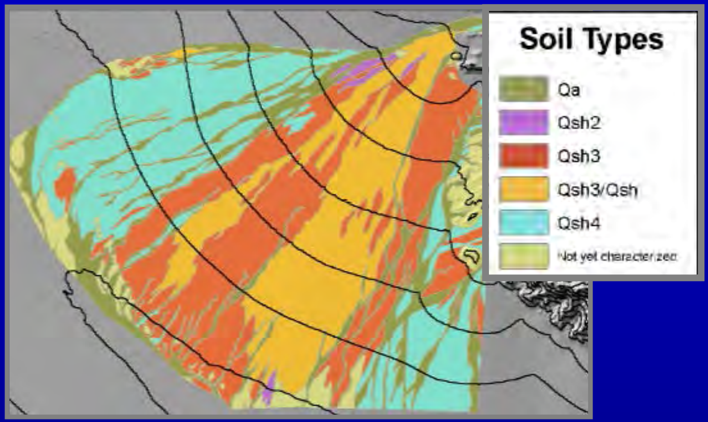
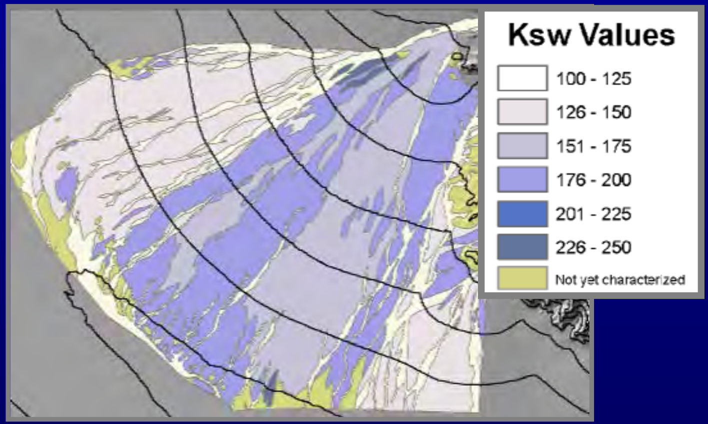
Assessment and Improvement of Hydraulic Characterization of Alluvial Fans to Support Estimates of Recharge and Initial Abstraction
Initial Field Results for Basin 126A – Corn Creek Fan

- Upper figure shows geologic units across the fan, with ages increasing from Qa to Qsh4. Lower figure shows the spatial distribution of saturated hydraulic conductivity (Ksw) in units of cm day^{-1}.
- Results showed higher hydraulic conductivity for older soils than younger soils, but results were affected by higher variability within age classes because of plant mounds and bar/swale topography.
- Preliminary statistical analyses showed no significant difference in conductivity values for non-vegetated surfaces across fan.
- Vegetated surfaces appear to have significantly higher conductivity (with higher abstraction).





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Engineer Research and Development Center

Collaborative study by ERDC and DRI on the synergistic effect of temperature and soil texture on infiltration

Increasing temperature has two opposing effects on infiltration:

- Decreases water's viscosity, which Increases hydraulic conductivity
- Decreases hydraulic head

The latter effect is more pronounced in fine–textured soils.

These effects an now be predicted quantitatively for inclusion in hydrologic models.

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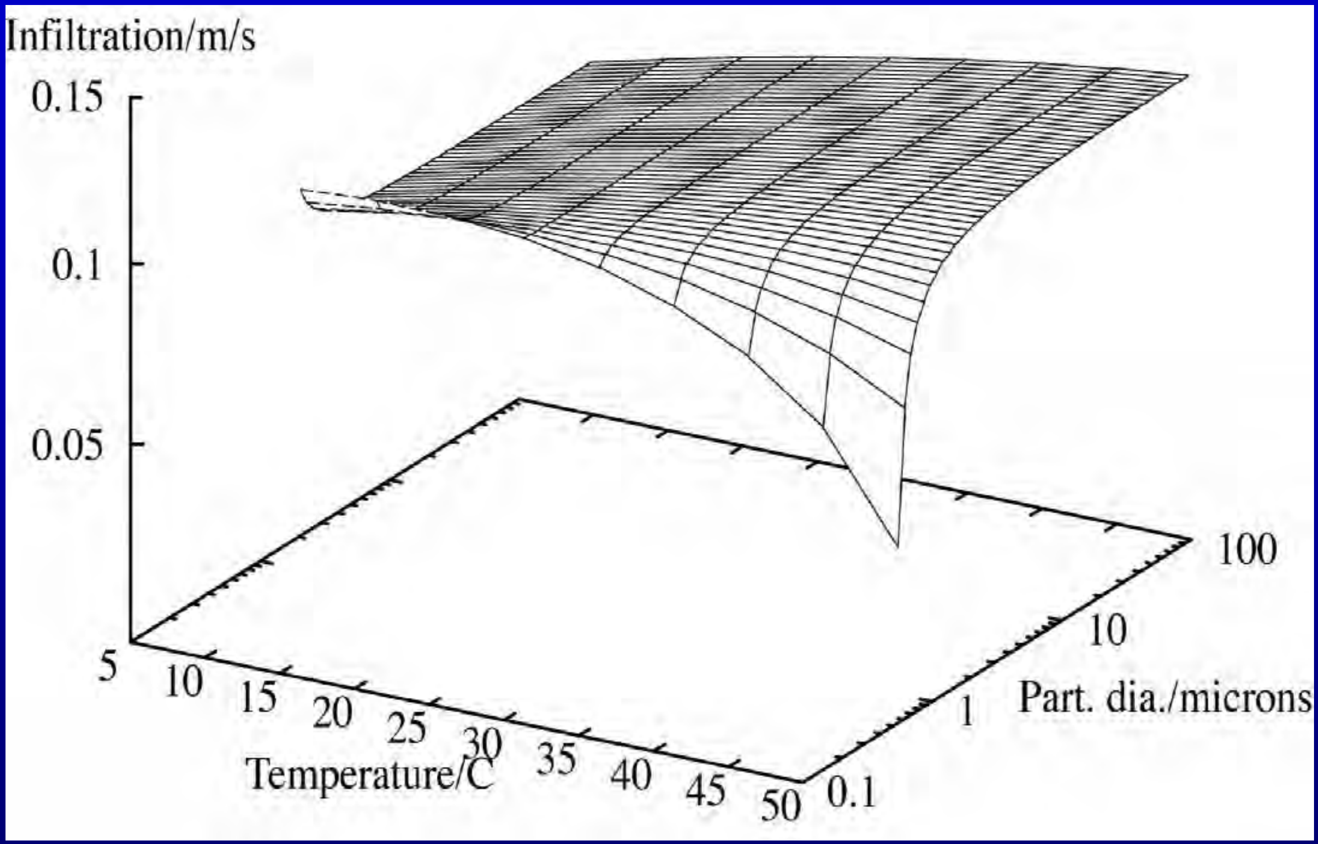
Temperature–soil particle size–infiltration rate surface for a Yolo loam



The effect is most pronounced in fine-textured soils at high temperatures.

Bed Load Transport Rate of Desert Gravel Channels

- Desert gravel streams usually have a coarser surface material than sub-surface material, which indicated the existence of an armor layer on bed surface.
- At base flow, sediment transport rate has not reached equilibrium, and limited by the supply from bed surface.
- Surface based sediment transport formulas (e.g. Wilcox and Crowe, 2003; Parker 1990; and Wu et al. (2002) are appropriate to predict bed load transport rate.

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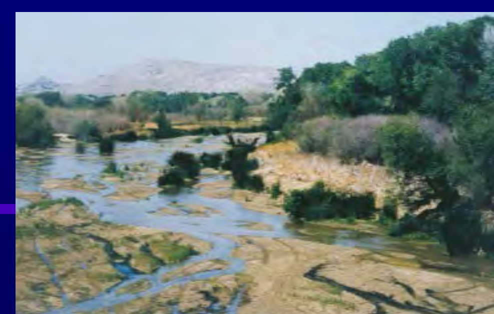
Riparian Vegetation Resistance Technical Note Content status: draft, out for review

- **Arid Riparian Systems**
  - **8 Systems Characterized**
  - **Vegetation Composition**
  - **Density**
  - **Resistance**
- **Guidelines**
  - **Flood Assessment**
  - **Restoration**
  - **Uncertainty**
  - **Stability**





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Urban Flood Demonstration Program: Home - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: http://www.ufdp-dev.dri.edu/ufdp_home.htm

Instant Message WebMail Calendar Radio People Yellow Pages Download Customize...

Urban Flood Demonstration Program

HOME | PEOPLE | PROJECTS | MODELS | DATA | SNWA

UFDP HOME

- Introduction
- Program Goal
- Demo Projects
- Identify Sites / Technologies
- Potential Demo Sites
- Objective
- Team Point-of-Contacts
- USACE-ERDC

introduction

The Urban Flood Demonstration Program (UFDP) is a collaborative effort between the U.S. Corps of Engineers Engineer Research and Development Center (ERDC) and the Desert Research Institute (DRI) based in Las Vegas, NV—and was initiated through a Congressional appropriation spearheaded by Senator Harry Reid (D-NV).

The UFDP is currently focused on Nevada, as a pilot study area for the entire arid and semi-arid southwestern U.S. Team members will test technology specifically designed and developed for reducing urban flood damage and restoring stream channels, at a number of sites that have been identified as “high priority”. Although these technologies will offer innovative strategies and solutions they must be strongly grounded in scientific concepts and theory, have a high probability of success and be capable of application in a range of arid and semi-arid settings.

The appropriation: The UFDP was initiated through an appropriation in PL 108-7, and specifically encouraged the Corps of Engineers to cooperate with the Urban Water Resource Program of the Desert Research Institute. A direct result of the efforts of Senator Harry Reid (D-NV), the UFDP began in FY03 and is funded, in part, by a Congressional allocation from the Corps budget. Alternative funding may be implemented by Congress in the future.

Top

DRI Desert Research Institute

US Army Corps of Engineers

Engineer Research and Development Center

Website

http://www.ufdp.dri.edu/

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Funded work units – new starts

- Development of volume-frequency relations (Las Vegas)
- Albuquerque – Rio Grande Bosque Feasibility Study: 2D sediment modeling and ecological studies
- Phoenix – Rio Salado and Rio Salado Oeste: 2D sediment modeling. Ecological evaluation.

What's next

- Technical transfer of products (website and other methods)
- Field and local involvement with ongoing work
- Leverage, collaborate, and cooperate to make our limited funds go further
- Continued feedback from districts and local stakeholders (information exchange, identification of issues and priorities, suggestions for future work)
- Goal: consensus on regional needs and priorities, and delivery of products that meet those needs
- Investigate potential for a continuing regional program

Regional Program

- FY05 submitted language includes reference to considering work in other urban centers in the western United States
- Identify and meet SPD needs and priorities
- Alternatives for program
- Legislative status

Further discussion…
any questions?

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A Dam Safety Study Involving Cascading Dam Failures

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Policy / Technical Issues

- How to account for the failure of “other” dams in the drainage basin
- How to account for the behavior of all basin dams acting as a system

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Outline

- Describe the physical situation
- Describe how the Kansas City District is addressing the problem
- Discuss the policy and technical issues

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Republican River Basin

Kansas , Nebraska and Colorado

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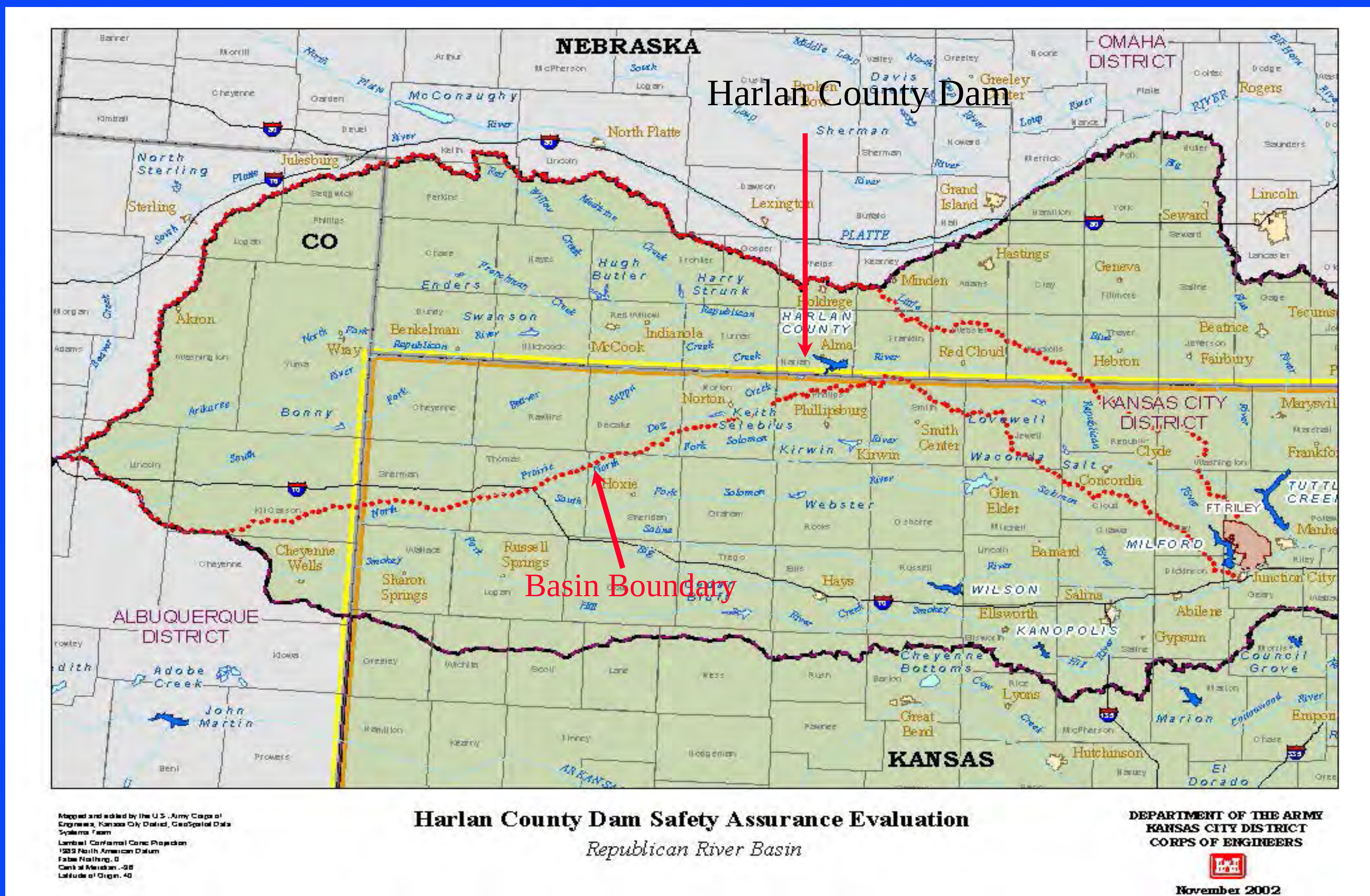
Republican River Basin



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The Great Republican River Flood of 1935

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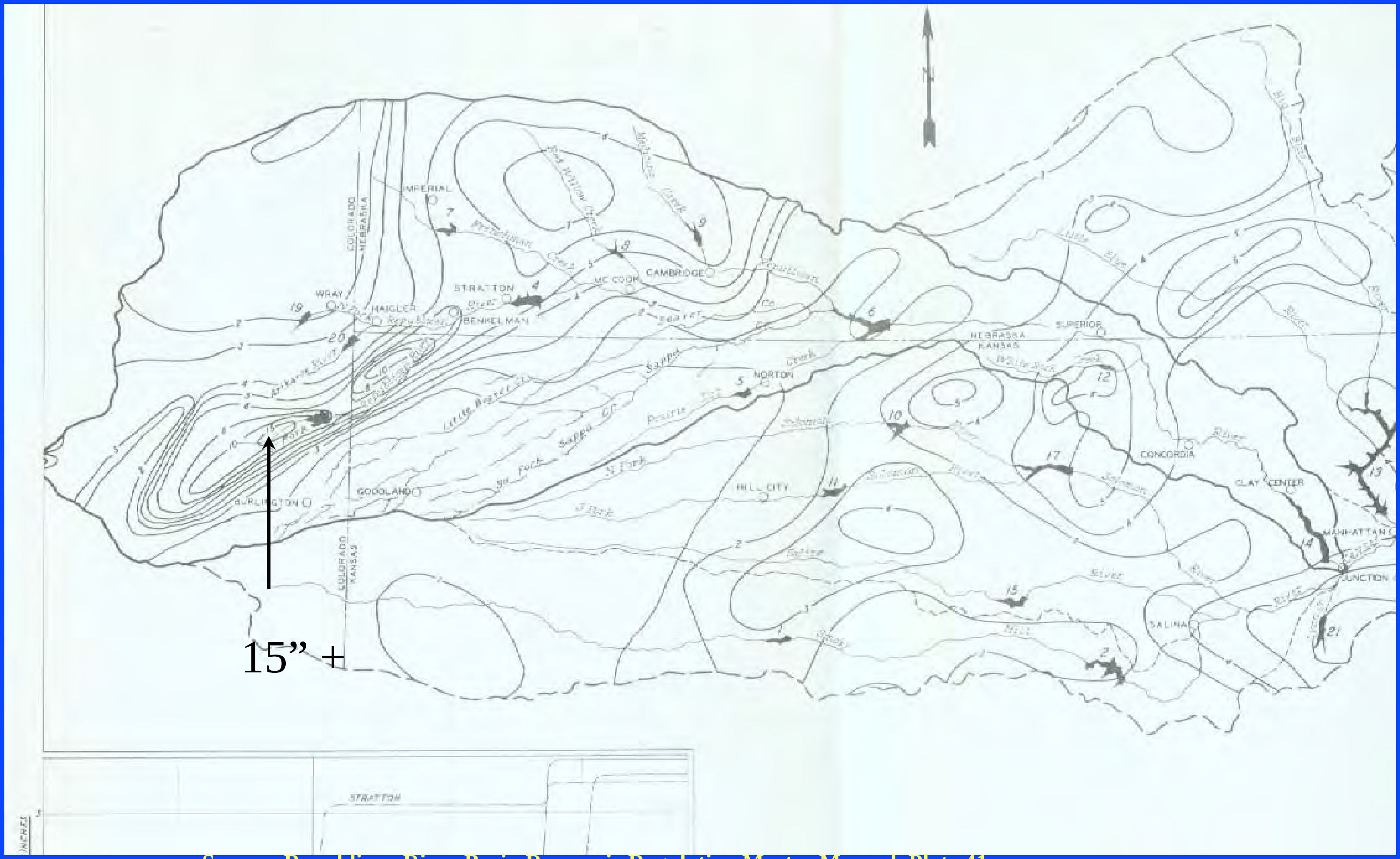
Kansas City District

Rainfall, 1935 Flood



Source: Republican River Basin Reservoir Regulation Master Manual, Plate 41

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1935 Flood

- Up to 24” (bucket survey)
- 113 people killed
- “Sunny Day” flood…..”Walls” of water
- Basin is kinematic
- At Harlan County damsite
  - Peak discharge…..280,000 cfs
  - Mean discharge for peak day……144,000 cfs

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COE Dam Safety Study
Harlan County Dam

Harlan County , Nebraska

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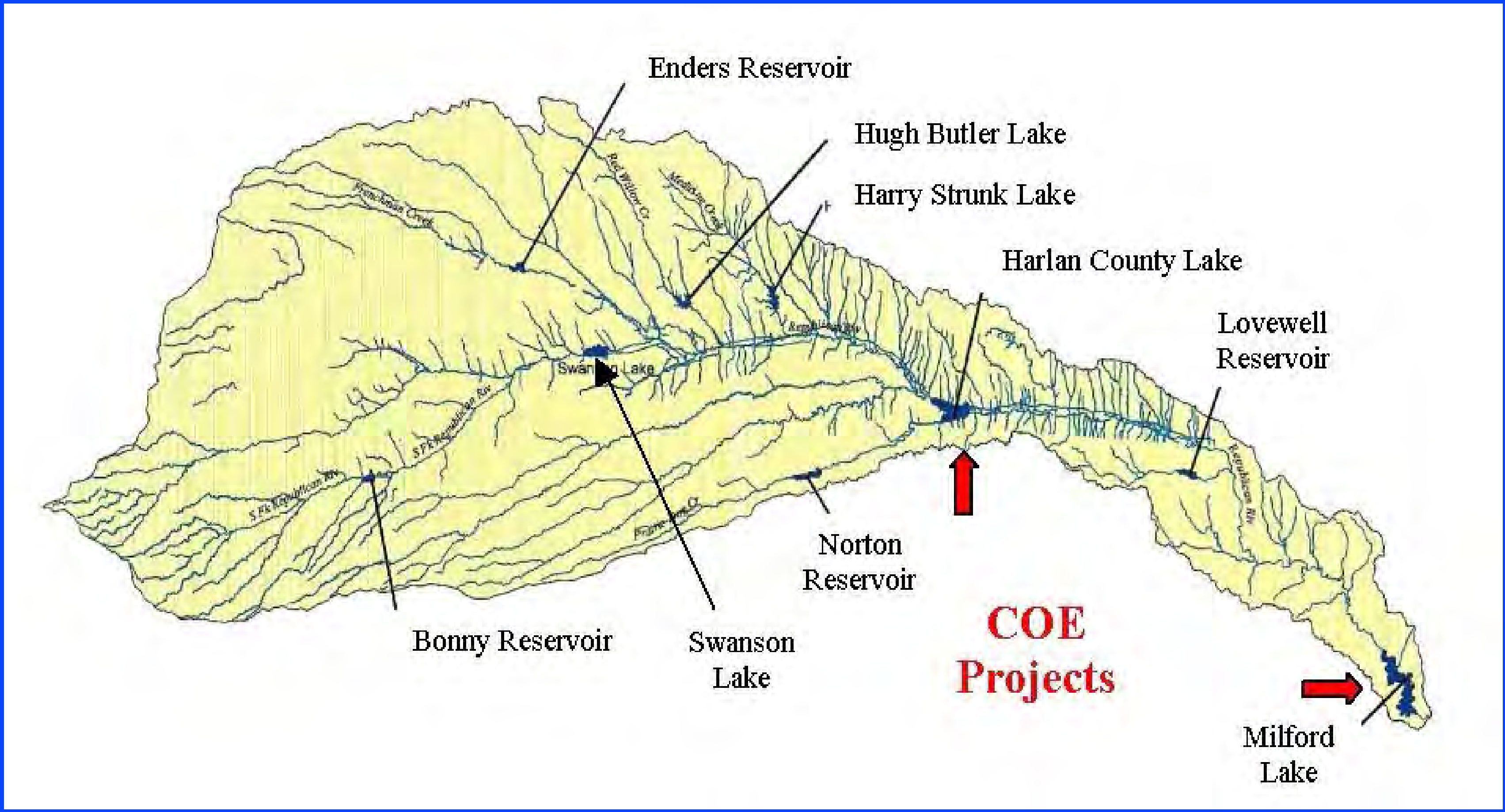
Dams in the Republican River Basin



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Two Corps of Engineers Flood Control Projects

- Milford Dam (near mouth of Republican River)
- Harlan County Dam (near midpoint of River)

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Seven Bureau of Reclamation Irrigation/Flood Control Reservoirs

- Bonny
- Swanson
- Enders
- Harry Strunk
- Hugh Butler
- Keith Sebelius
- Lovewell

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Four Dams in Series (Cascade of Failing Dams)

- Bonny
- Swanson
- Harlan County
- Milford

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Critical population centers and high value economic locations are downstream of Milford Dam in the Kansas River Valley….

Therefore, to fully evaluate impacts of a dam failure, the performance of the entire system must be analyzed

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Overall Objective of ER 1110-8-2(FR)

Inflow Design Floods for Dams and Reservoirs

Find the worst possible hydrologic event applicable to a dam or reservoir

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"Normal" COE Dam Safety Study Procedure

- Determine Probable Maximum Precipitation (HMR 51)
- Develop Runoff Model of Basin
- "Center" PMP in Basin to Produce Maximum Depth of Rainfall in Basin (HMR 52)
- Apply Rainfall to Model to Produce Inflow Hydrograph
- Peak Hydrograph by 25-50 %
- Determine Project Response to Peaked Hydrograph

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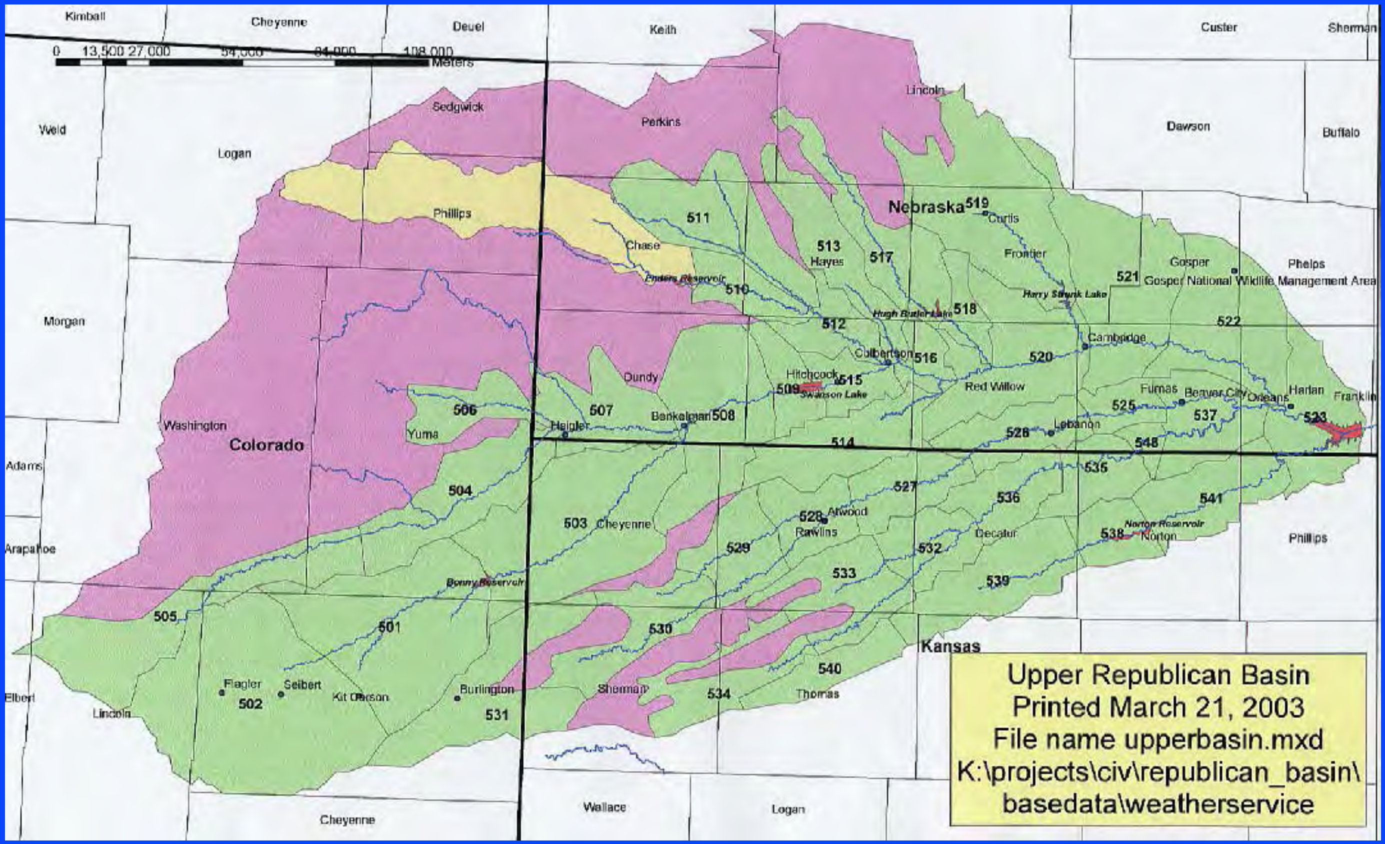
One Complicating Factor
Non-Contributing Areas



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Kansas City District's Study Methodology

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PMP Rainfall

- Determined Maximum Rainfall Depth using HMR 51 for Harlan County Dam
- Determined Critical Center of Rainfall for Harlan County Dam
  - Only Contributing Drainage Area
  - Upstream Dams Were Ignored..(but performance of these dams was accounted for in the HMS model)

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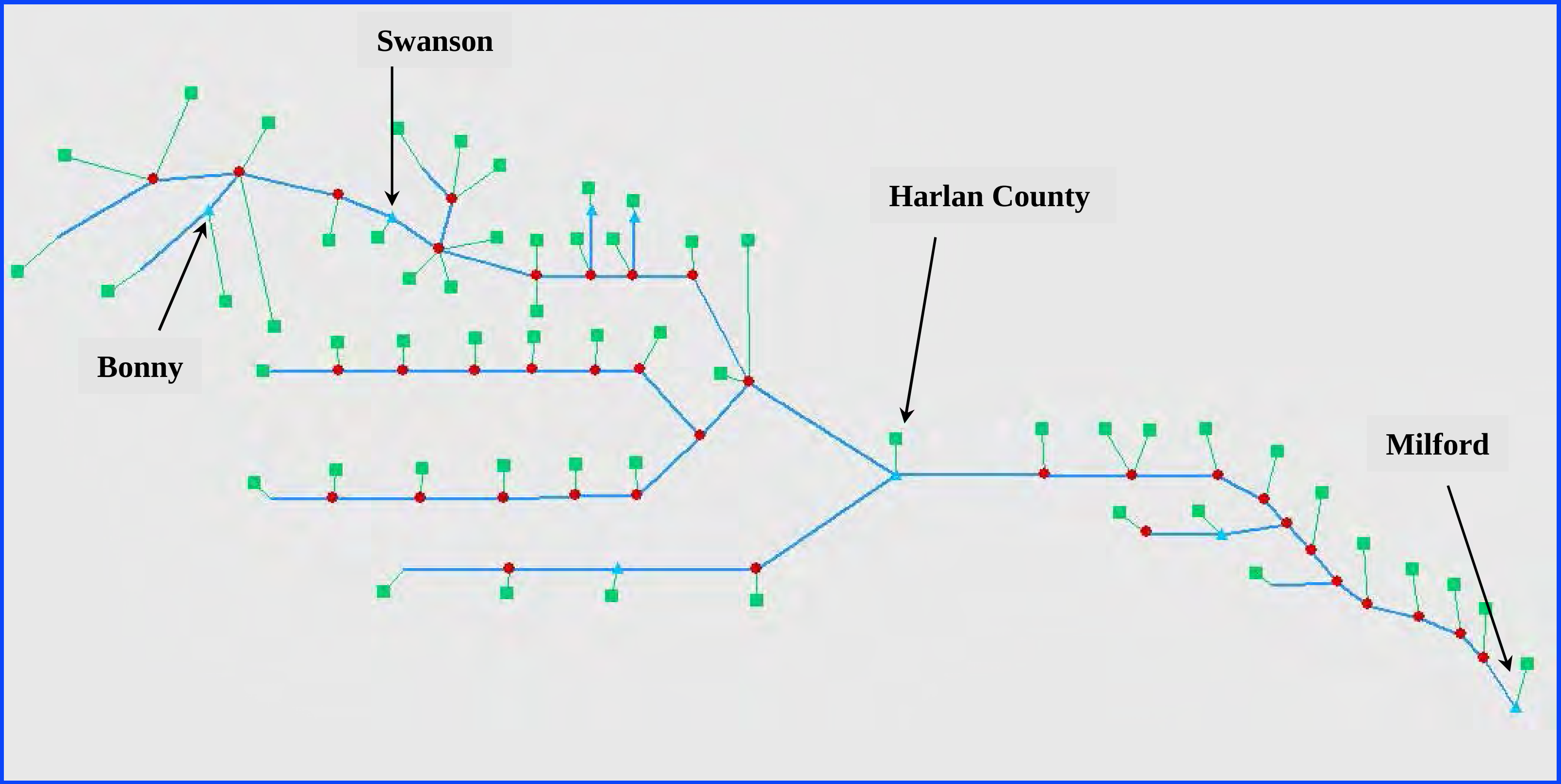
Developed Republican River HEC-HMS Model



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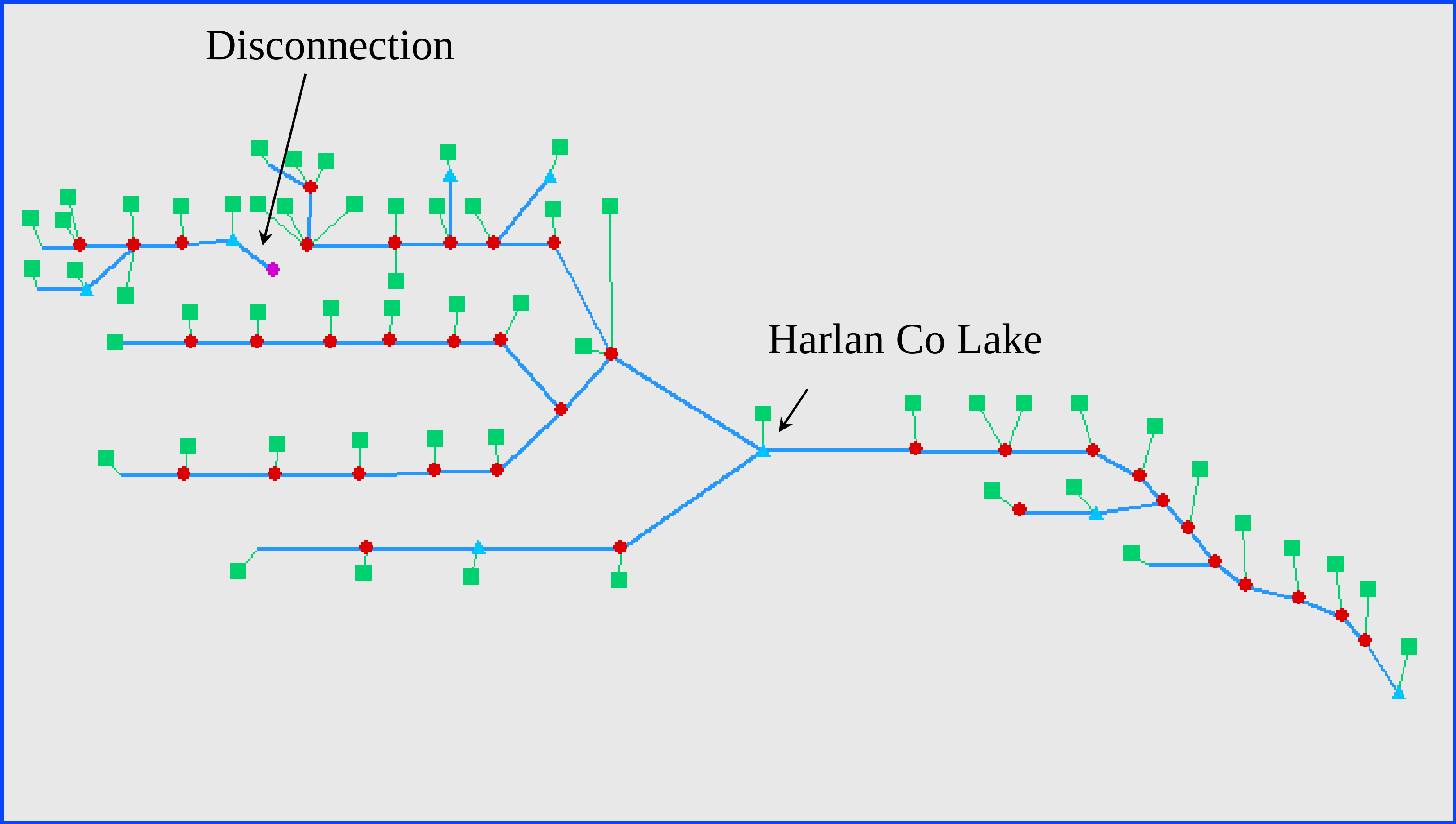
Swanson Sink Version



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Using Swanson Sink Model and HMR52 Rainfall…..

- The Inflow Hydrograph to Swanson Dam Was Computed
  - (Would Swanson Dam be Overtopped?)
- The Inflow Hydrograph(s) From All Subbasins Between Swanson Dam and Harlan County Dam Were Computed

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If Swanson Dam Failed……

- The Rupture of Swanson Dam and the Movement of the Resultant Floodwave was Routed to Harlan County Dam using UNET (DOS Version)
  - Reservoirs treated as storage areas
  - EF (Embankment Failure) record used

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Inflow Hydrograph

Combine Hydrographs

Check Peak Discharge and Compute Volume

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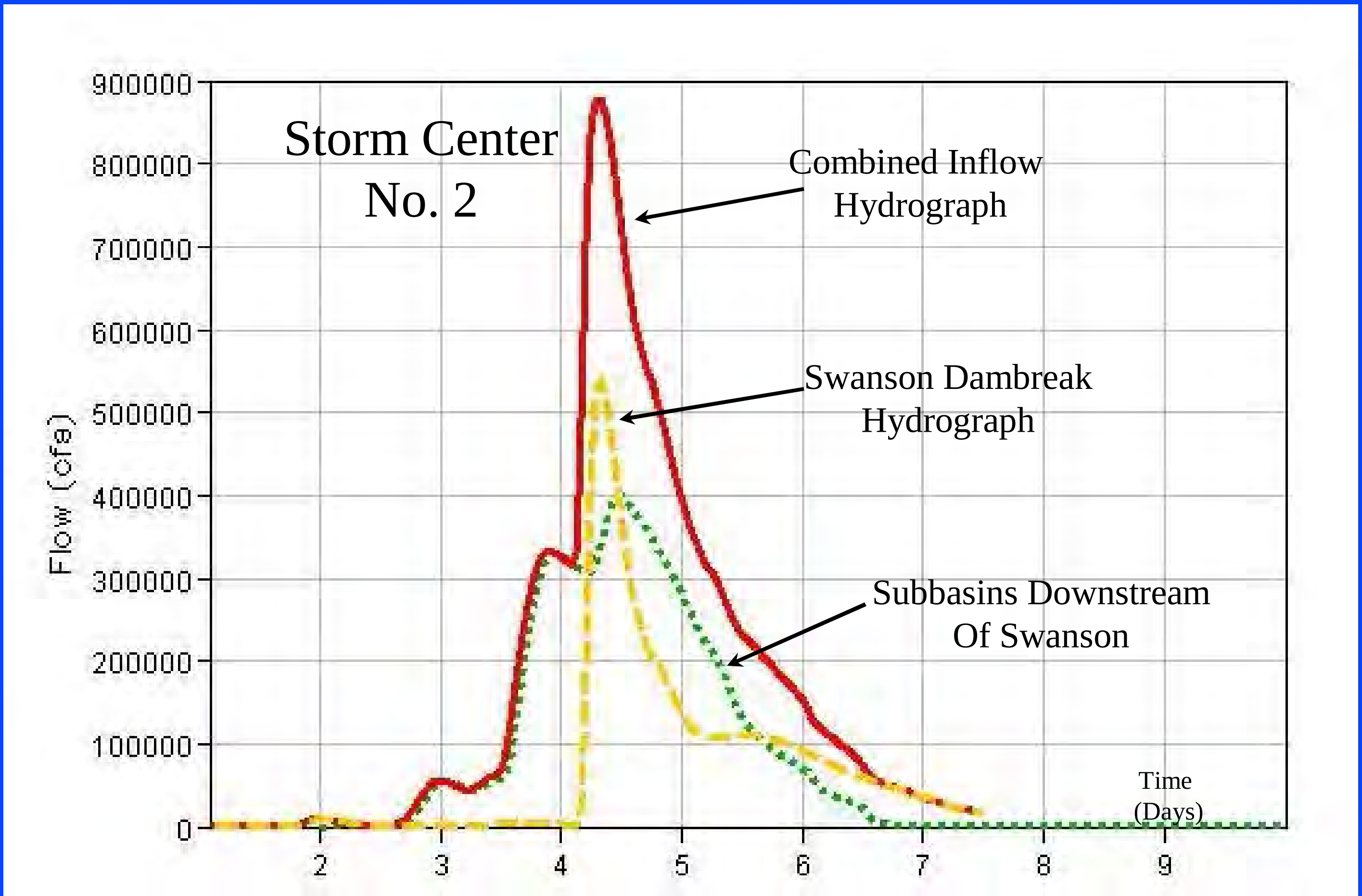
Representative Hydrograph



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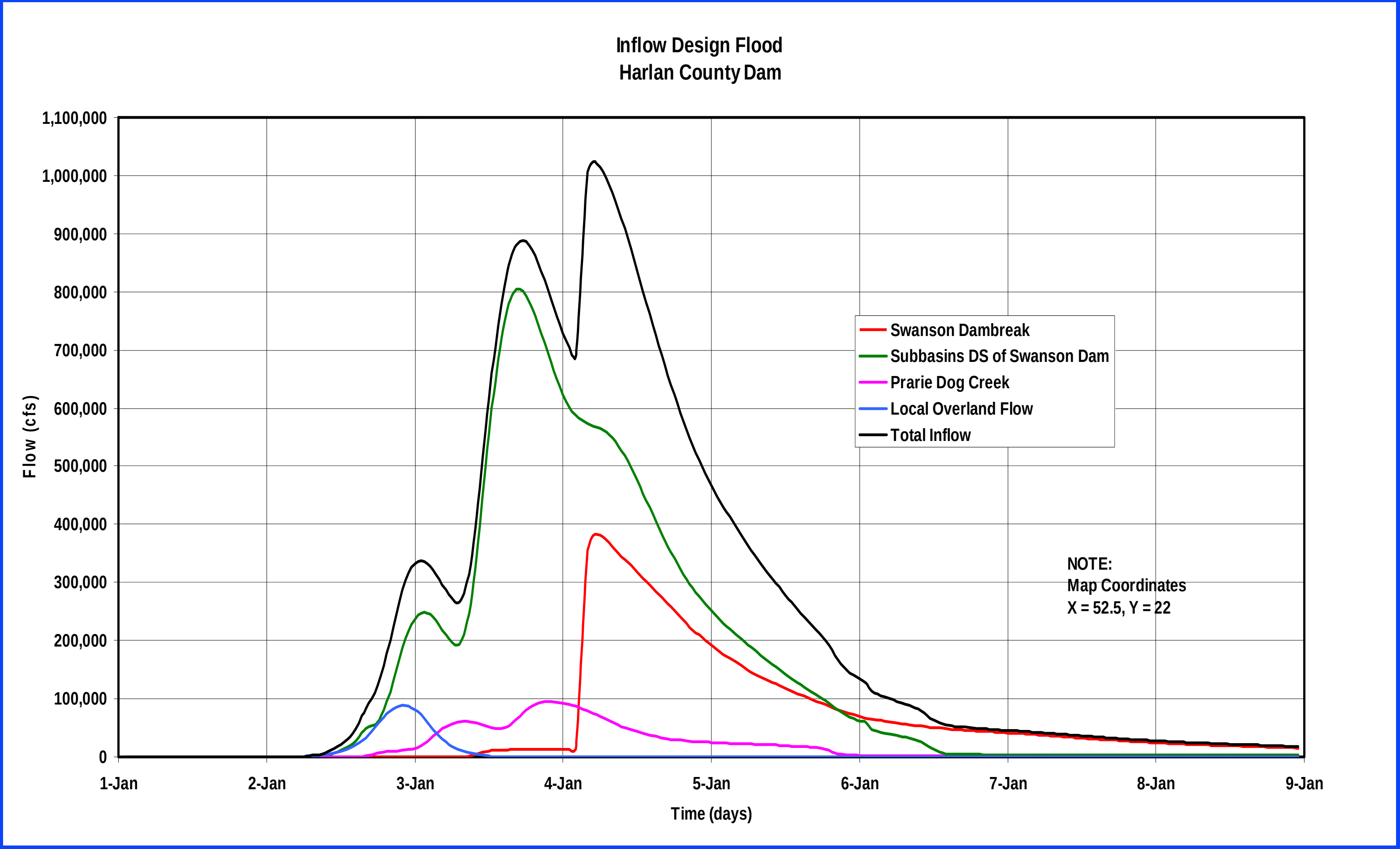
Critical Hydrograph



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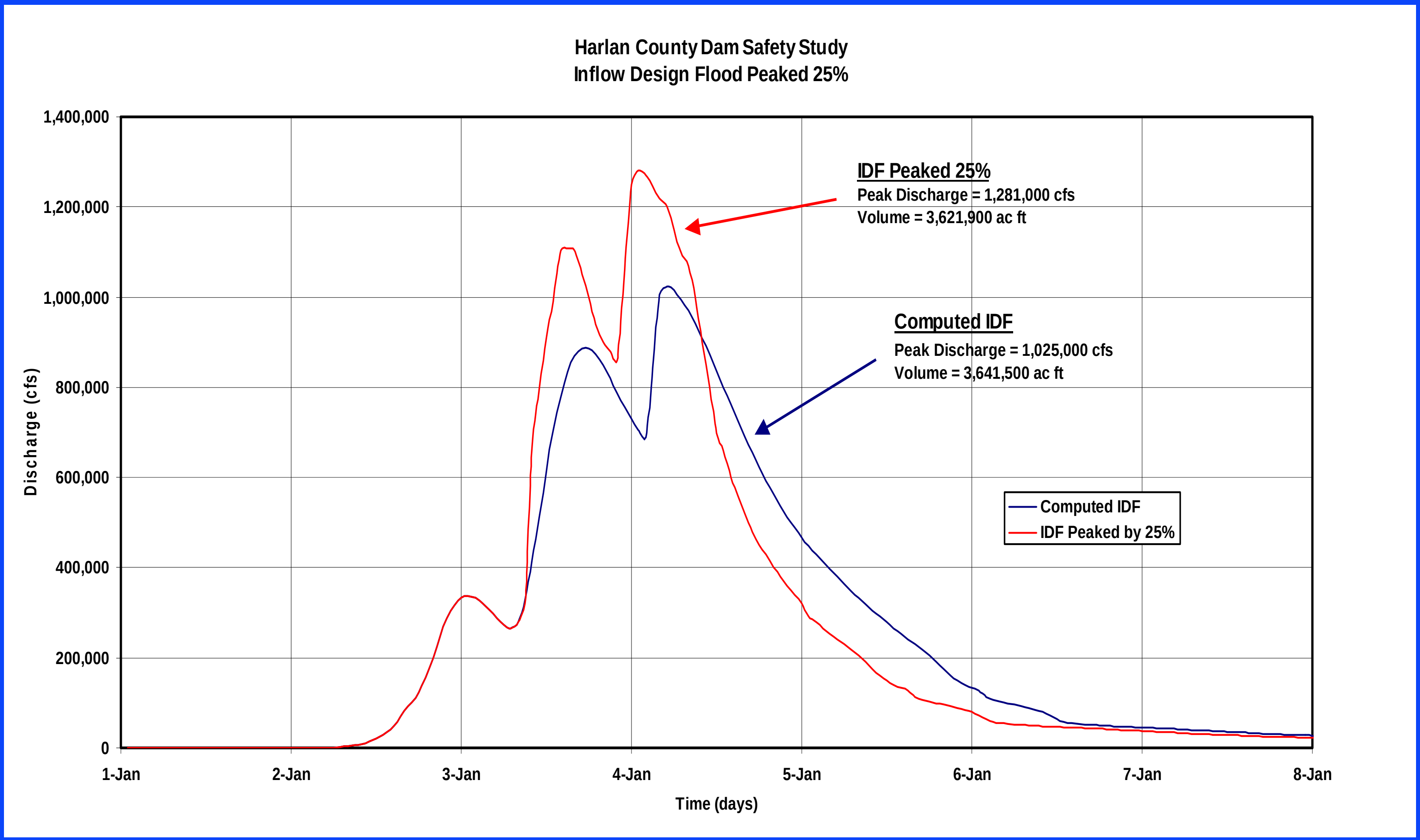
Critical Hydrograph Peaked 25%



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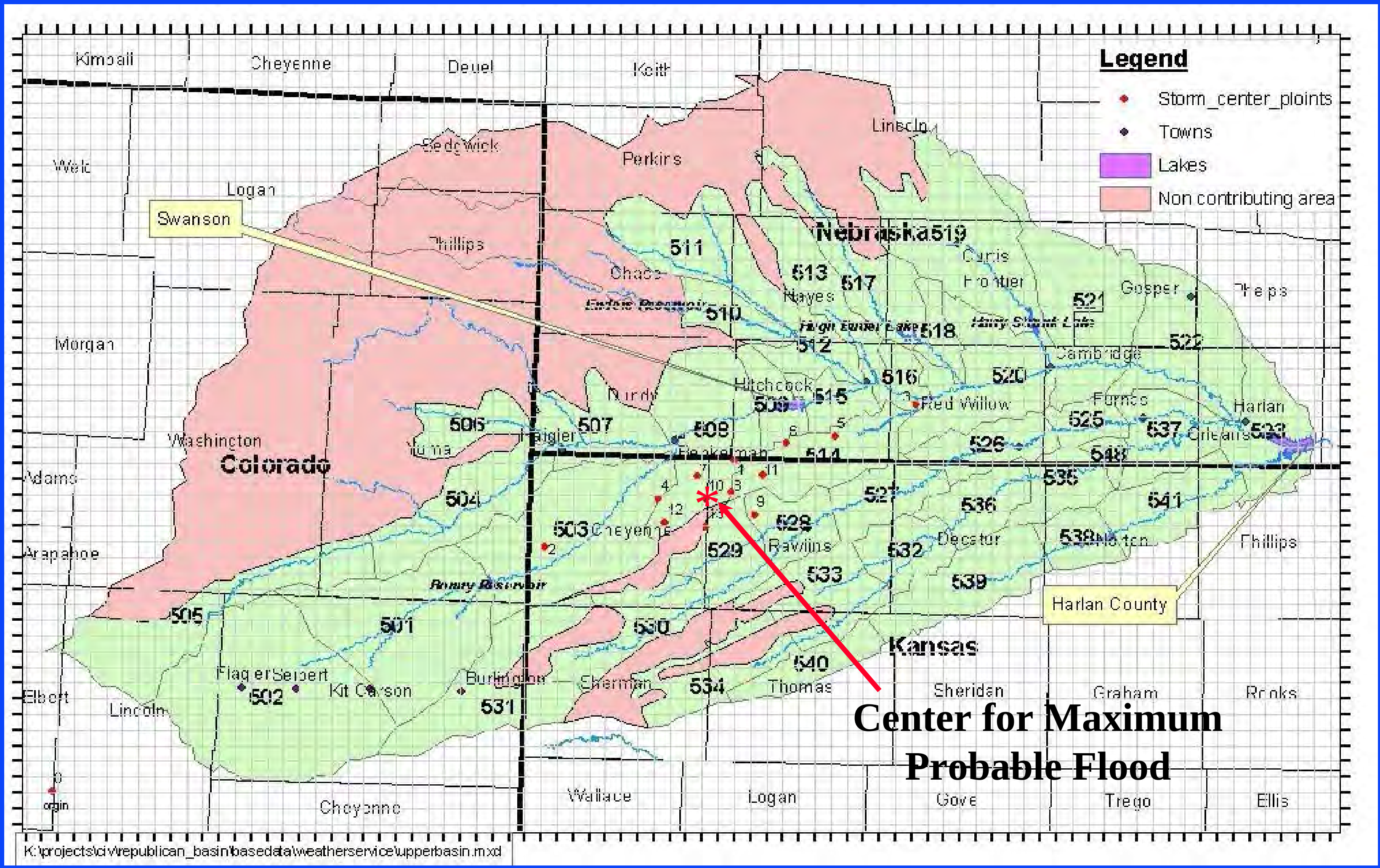
Storm Centers



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Lessons Learned

- Watch the volumes
  – When using UNET, make sure that extra storage above the top of dam does not find its way into the outflow hydrographs
- When using an HEC-HMS model to determine reservoir inflow. The proper inflow is the sum of the inflows from the tributaries.

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Observations

- The Kansas City District is reasonably content with the methodology used to compute the inflow hydrograph
- A UNET model will be used to track the failure of Harlan County Dam and the movement of the floodwave into the Milford Dam pool
- Milford Dam is not expected to fail

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Observations

- To the area downstream of Milford Dam, the difference between a failure and non-failure of Harlan County Dam is the release of the volume of water stored by Harlan County Dam into the Milford pool. This affects the discharge through the spillway at Milford Lake.

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Observations

- Since the population centers and high damage areas (mostly protected by levees) are downstream of Milford Lake, the response of the entire system is critical
- To properly account for the system response, the initial condition of Milford Lake is critical

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Two Approaches to Antecedent Conditions Suggested in ER 1110-8-2(FR)

- Assume the reservoir pool is at the top of the flood control pool at the onset of the IDF
- Assume the reservoir pool is at its normal elevation, then a storm equal to ½ PMP occurs, followed by a five day lag, then the full PMP occurs
- Use whichever condition is "most appropriate"

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Kansas City District Approach

- Exploring second antecedent condition option
- Preliminary flood has been developed using ½ PMP rainfall
- It was fortunate that Swanson Dam did not fail for the ½ PMP because it will fail later under the full PMP
- The ordinates of the preliminary storm are less than ½ ordinates for the full PMP due to storage effects of the BOR reservoirs

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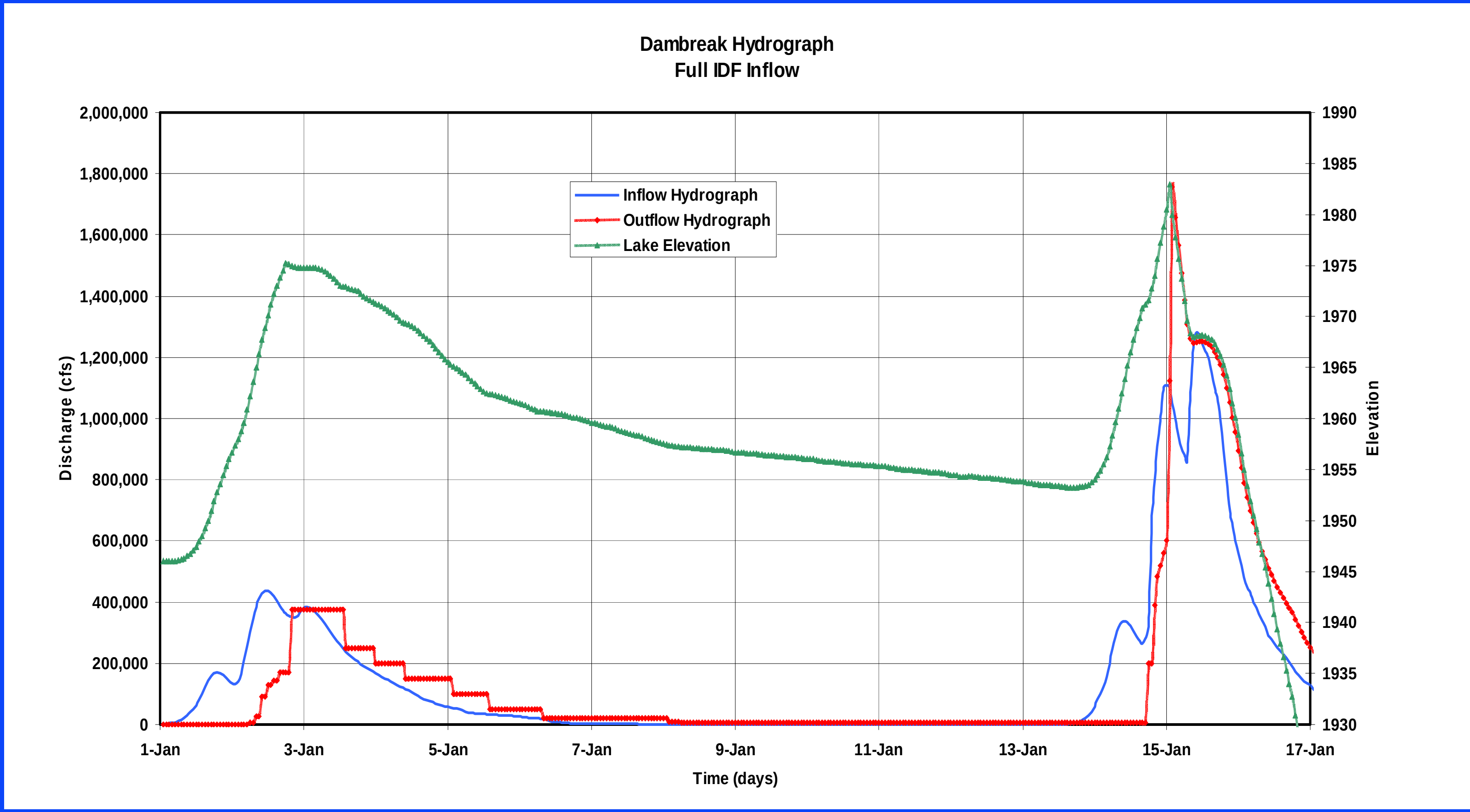
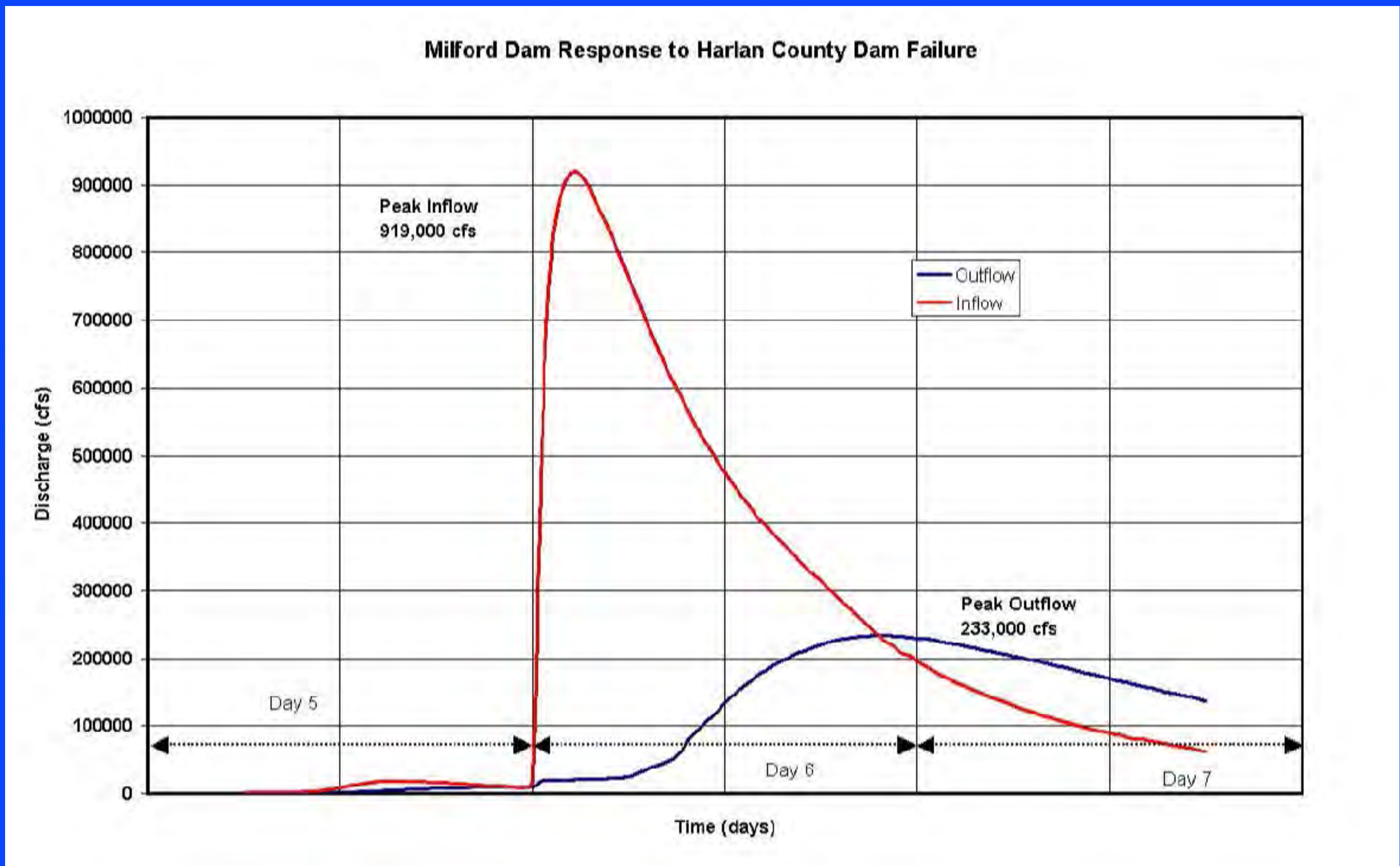
Kansas City District

Use of Preliminary Storm at Harlan County Dam



US Army Corps of Engineers
Kansas City District

Milford Dam Response (Preliminary)



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Kansas City District

While this “preliminary storm” approach seems reasonable for the full PMP, it may present problems in the determination of the Base Safety Condition, where fractions of the Inflow Design Hydrograph are evaluated

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This presentation is not intended to be a "how-to-do-it", but rather is a "how-we-did-it"…..

We believe this effort is in compliance with the spirit of the USACE Dam Safety Regulation

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However, this study raises important technical/policy issues…….

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Kansas City District

Issue No. 1
How to evaluate other dams in the basin that do not pass the PMP

- Owned/operated by responsible public body (BOR, TVA, COE, States, etc.)
  – Assume they will be brought up to standard
  – Evaluate them as you find them
- Owned/operated by others (private, homeowners association, local park board, etc.)

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Issue No. 2

When multiple dams are present in a basin, what assumptions should be made with respect to the initial condition and performance of the other dams in the basin?

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Side Issue

There could be an issue with the owners of the other dams in the basin. No one likes to have their dam labeled "unsafe" by an outside party. Some sensitivity, particularly in public meetings, is required

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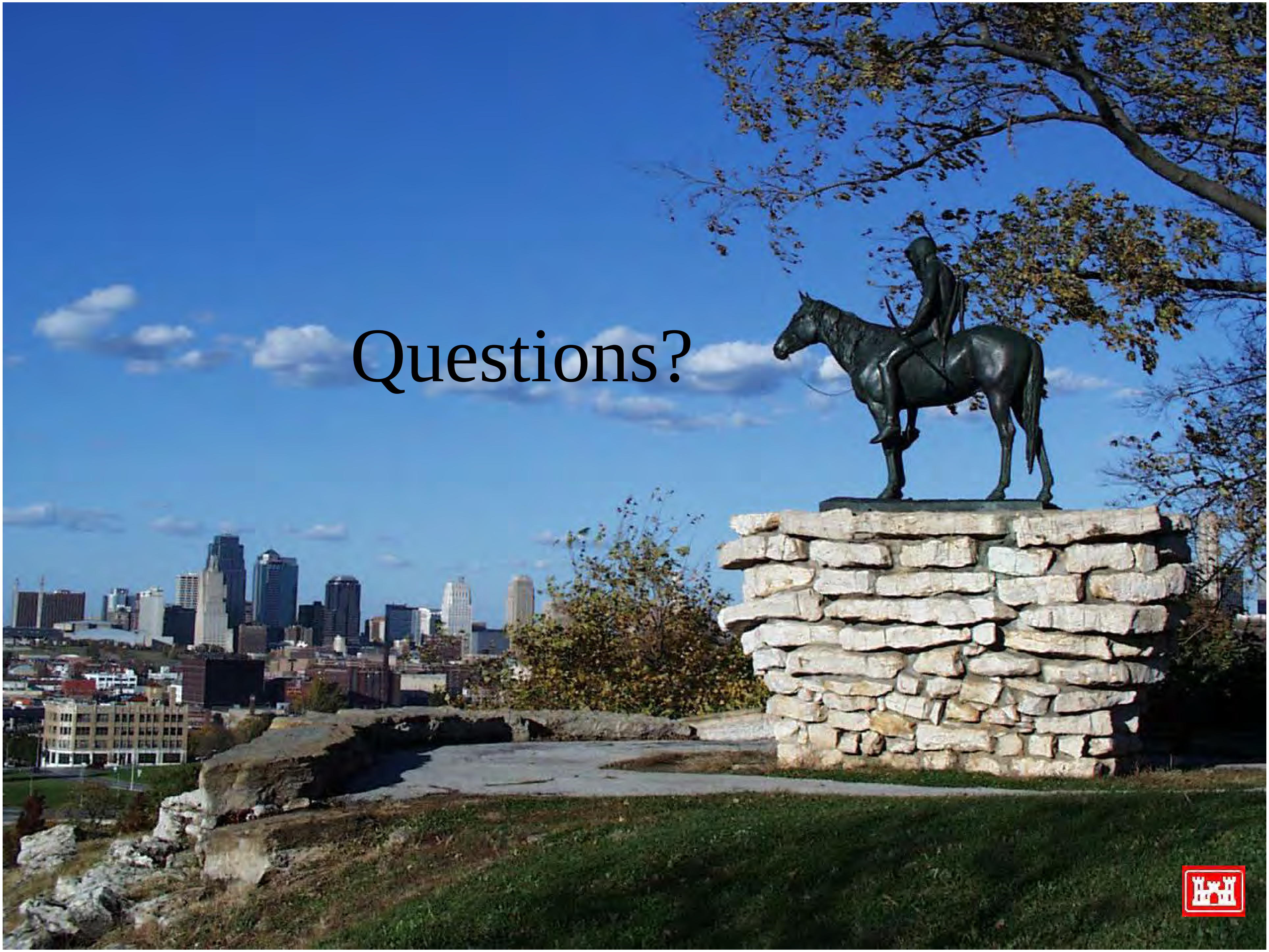
Side Issue
Could repairs to other dams be eligible for Federal funding, if repairs to that structure are part of the least cost solution ?


Questions?

GIS Tools Available Now to Support HH&C

or

Geospatial Integration of Hydrology & Hydraulics Tools for Multi-Purpose, Multi-Agency Decision Support

Timothy Pangburn, Joel Schlagel, Martha Bullock, Michael Smith, and Bryan Baker

2005 Tri-Service Infrastructure Systems Conference & Exhibition

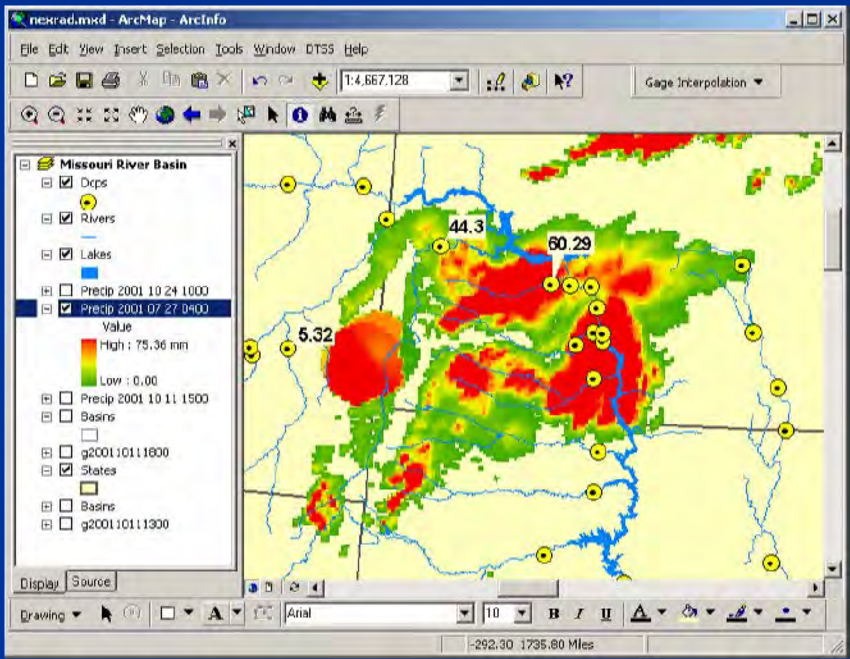
HH&C Track

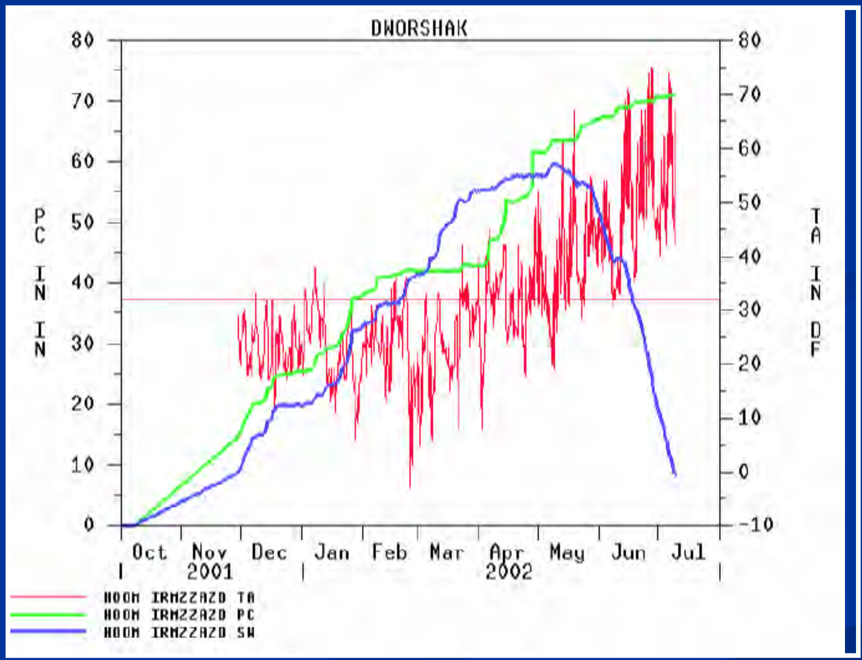
3 August 2005

Outline

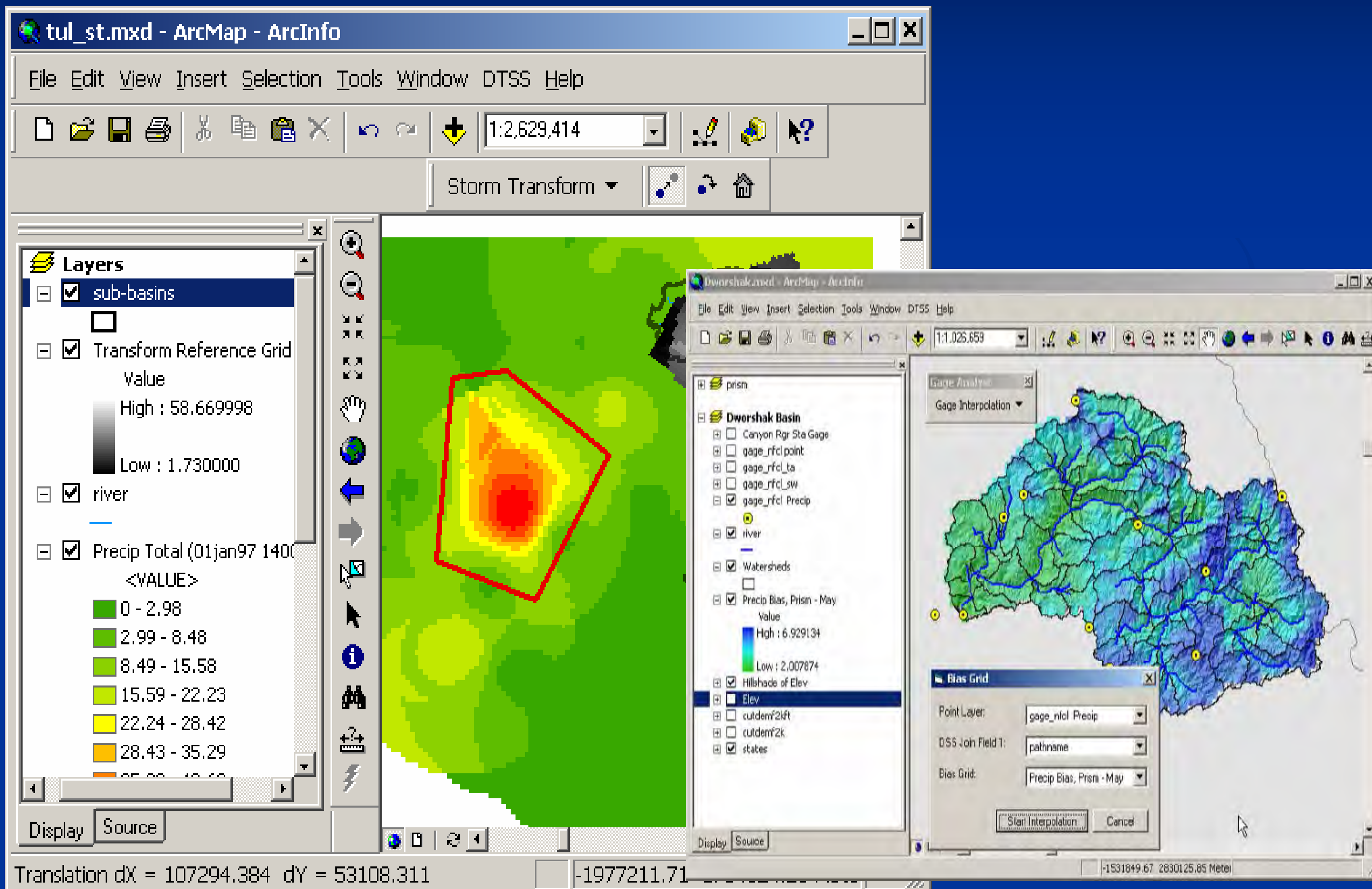
- ArcGIS Applications
  - Hydrologic Processors
  - Reservoir Inundation Calculator
- CorpsViewWeb
- CorpsMap
- NAE CWMS Applications
- Missouri River Geospatial Decision Support Framework
- Future Viewers

Distributed Input for Hydrologic Models using Object-Oriented Tools





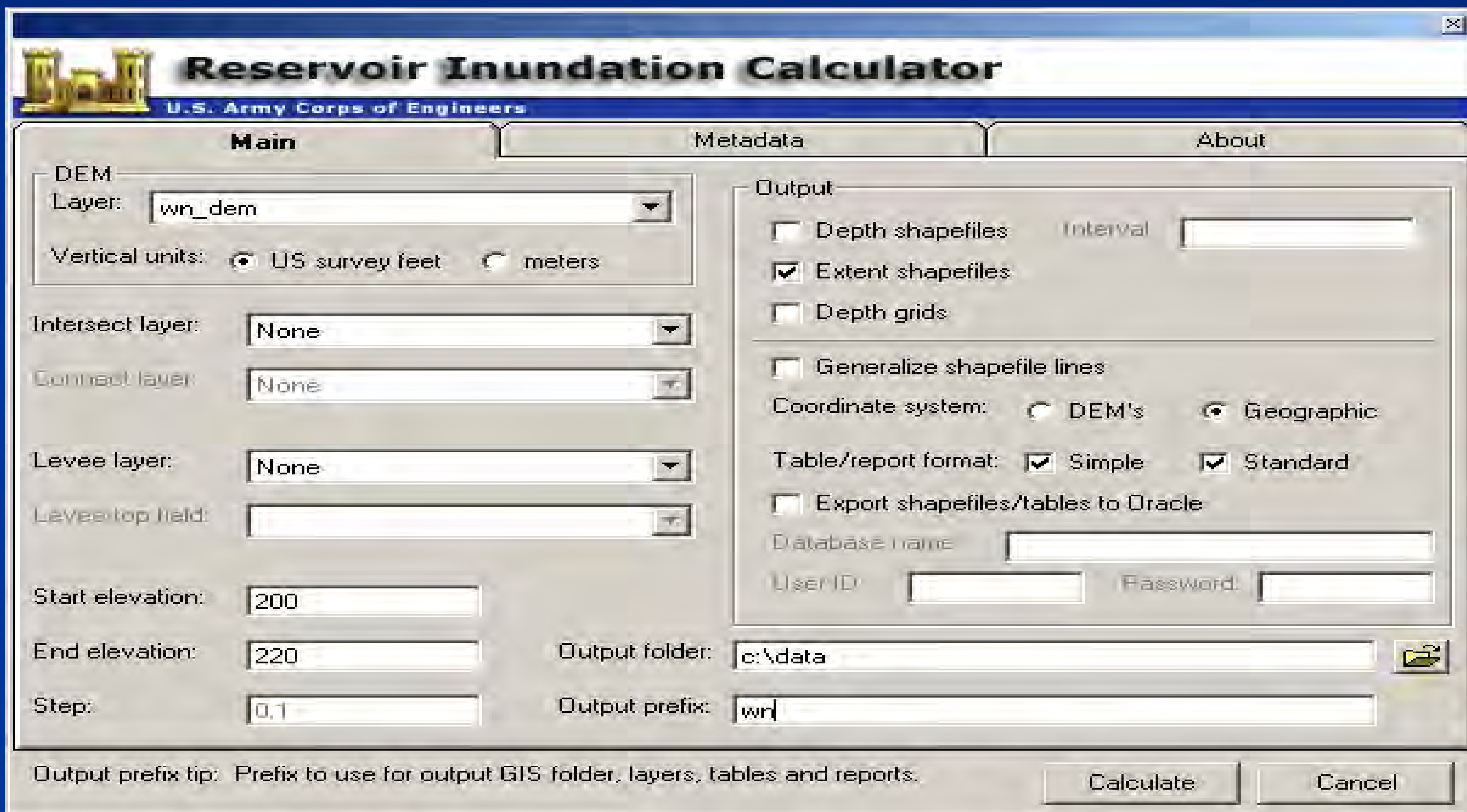
Object-Oriented Tools for Interpolation of Meteorological Parameters for Hydrologic Modeling



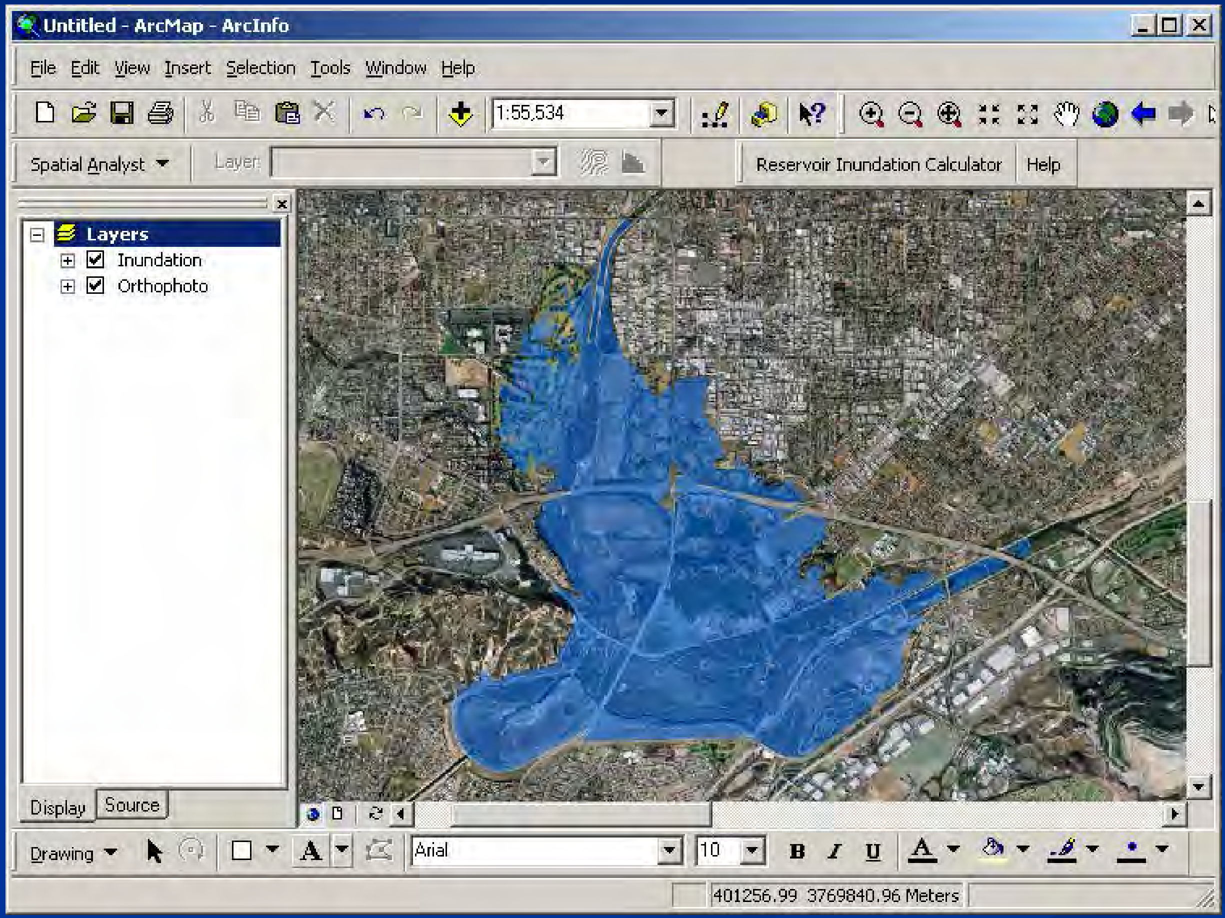
Reservoir Inundation Calculator Background

- Developed in collaboration with the US Army Engineer District, Los Angeles
- ESRI ArcGIS extension
- Calculates inundation GIS layers and area and capacity values for reservoir water levels

Reservoir Inundation Calculator Interface



Reservoir Inundation Calculator GIS Output Example



Reservoir Inundation Calculator Report Output Example

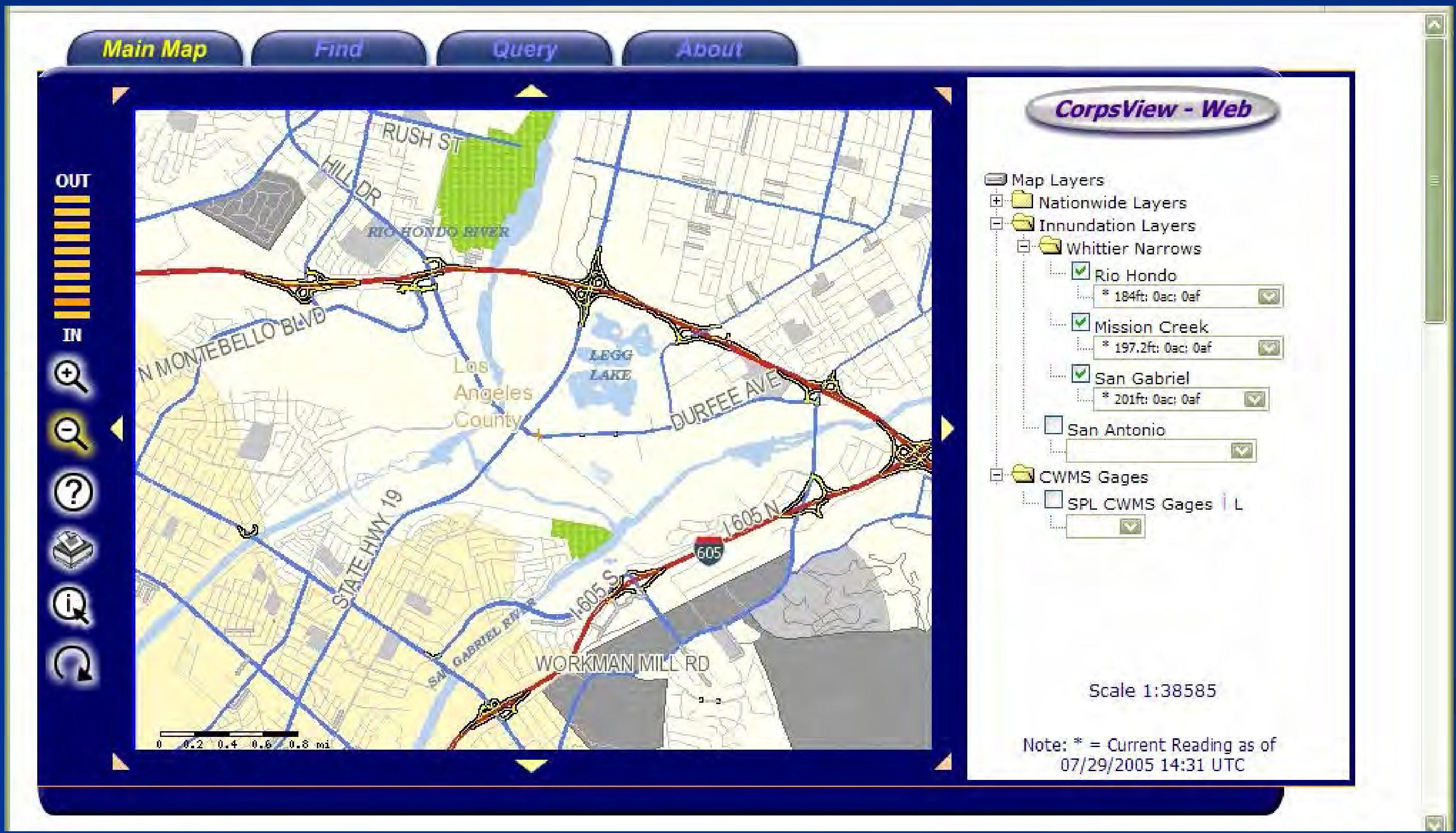
Great Day Reservoir, CA - Capacity Table
Survey date: July 15, 2004
Elevation in feet, Capacity in acre-feet

Elev	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
210	6717	6795	6873	6952	7032	7112	7193	7274	7357	7441
211	7527	7615	7703	7792	7882	7972	8062	8153	8245	8337
212	8430	8523	8616	8710	8805	8900	8996	9092	9189	9286
213	9384	9483	9582	9682	9782	9883	9985	10087	10189	10292
214	10396	10500	10606	10714	10823	10933	11044	11155	11267	11380
215	11493	11607	11721	11835	11951	12066	12183	12300	12418	12536
216	12655									

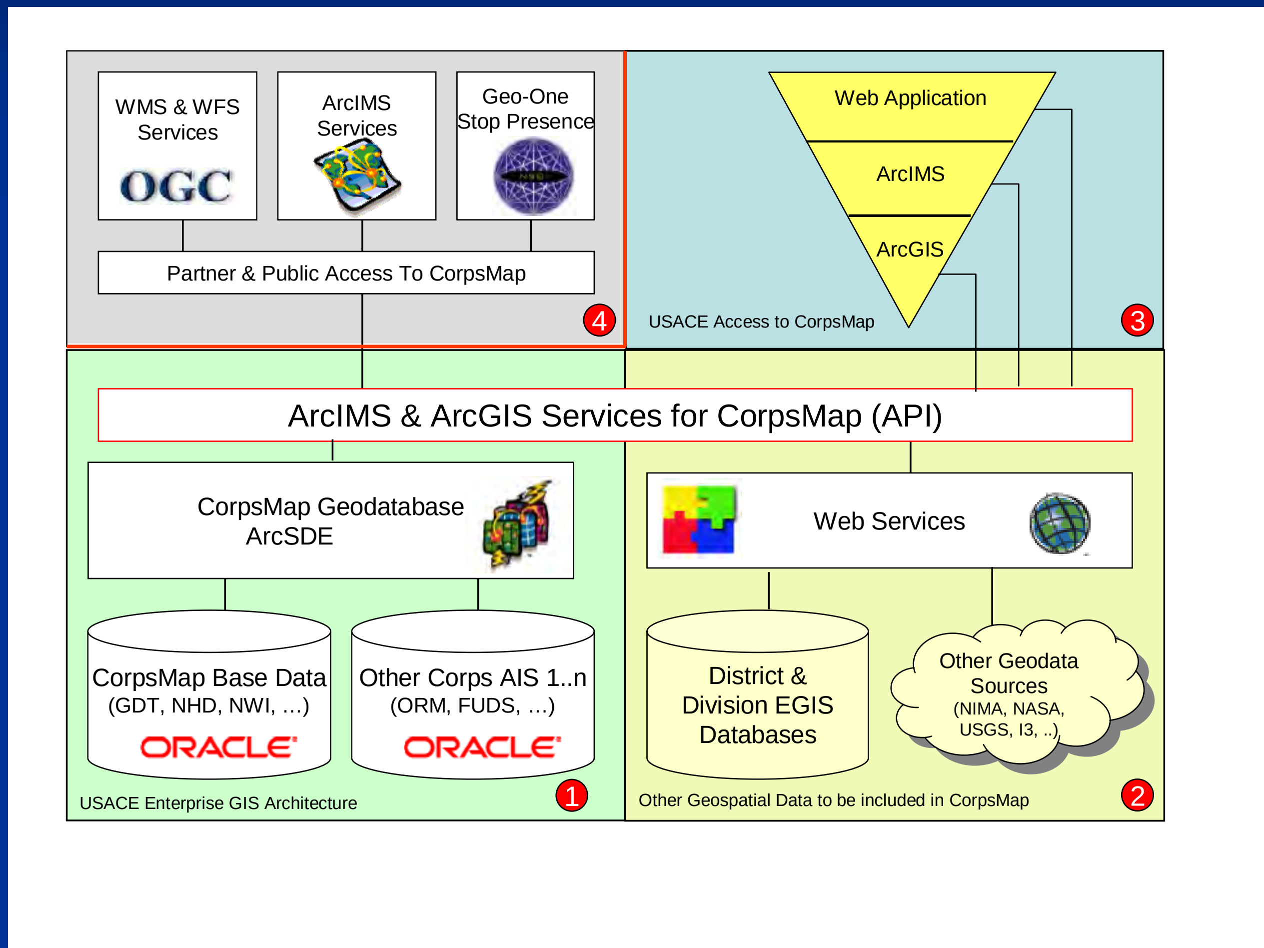
Report Details

Reservoir name: Great Day Reservoir
Reservoir state: CA
Report created by: Tim Baldwin
Organization: US Army Corps of Engineers
Reservoir Inundation Calculator run date: September 29, 2004
Vertical datum of elevation used in Calculations: NGVD29
Survey date: July 15, 2004
Survey description: LIDAR
Survey source: Hard Working Surveyor Company

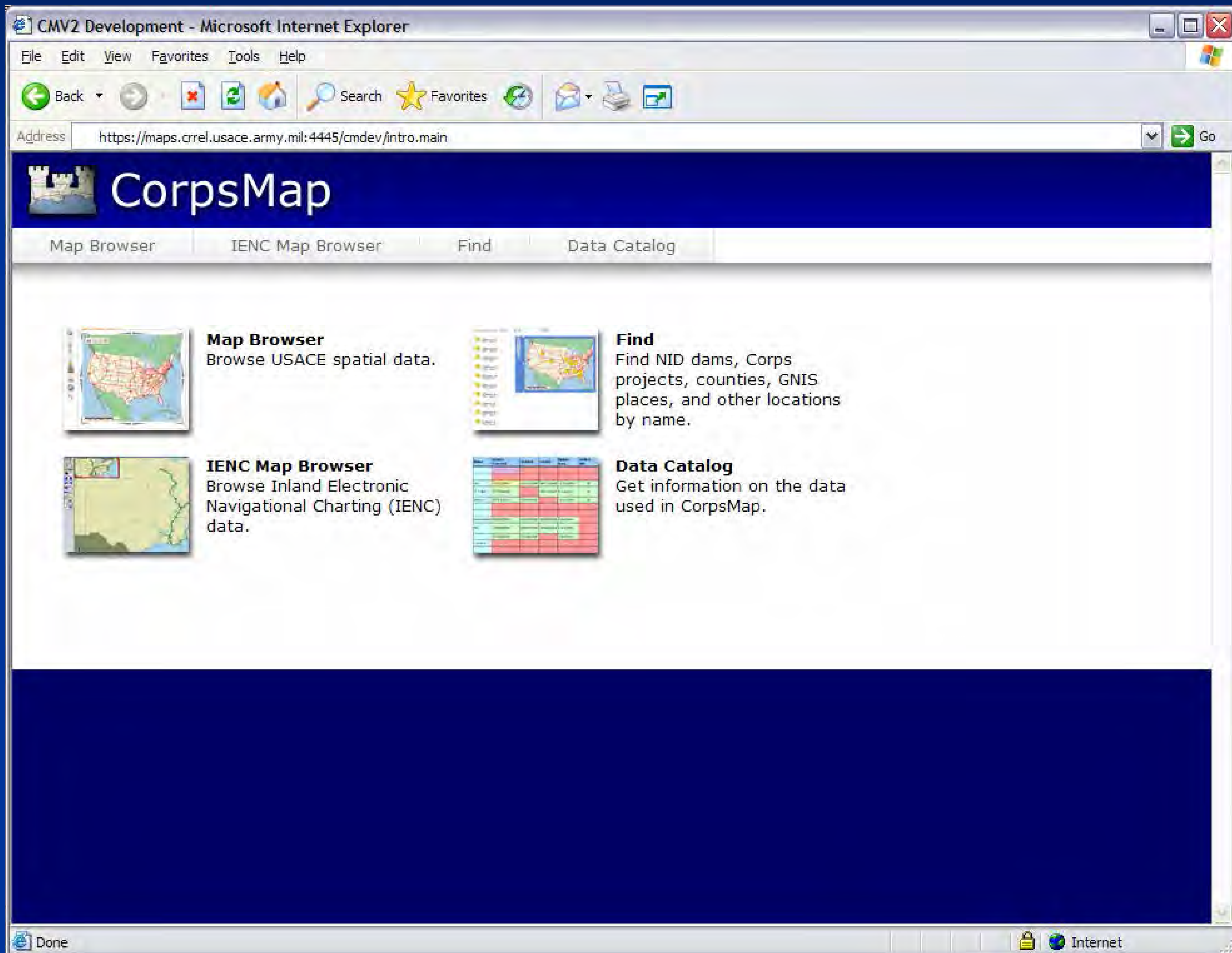
Output of ArcGIS Inundation Calculator visualized with CorpsView and integration with CWMS Real-time Conditions



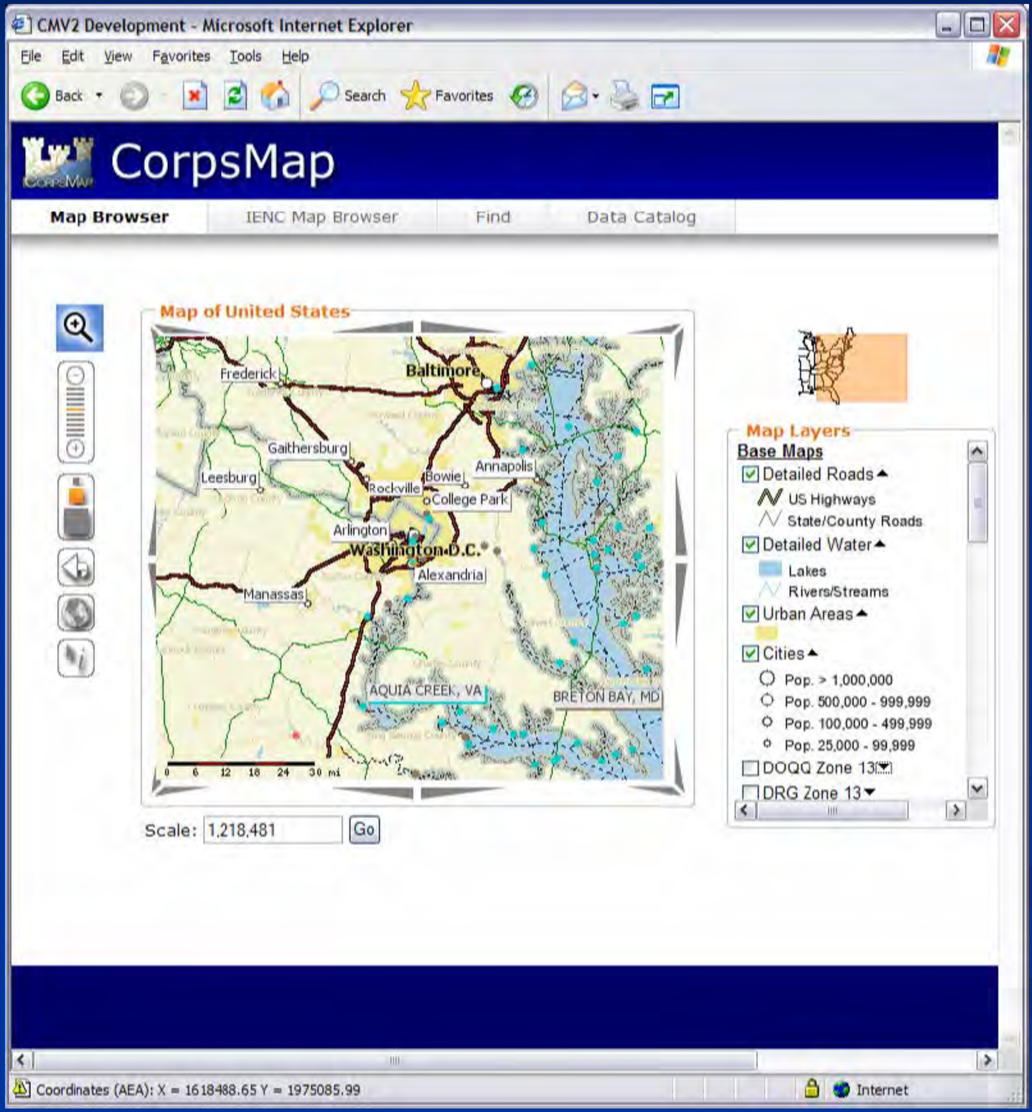
A Database Driven Remote Sensing & GIS Architecture for Basin-Wide Studies



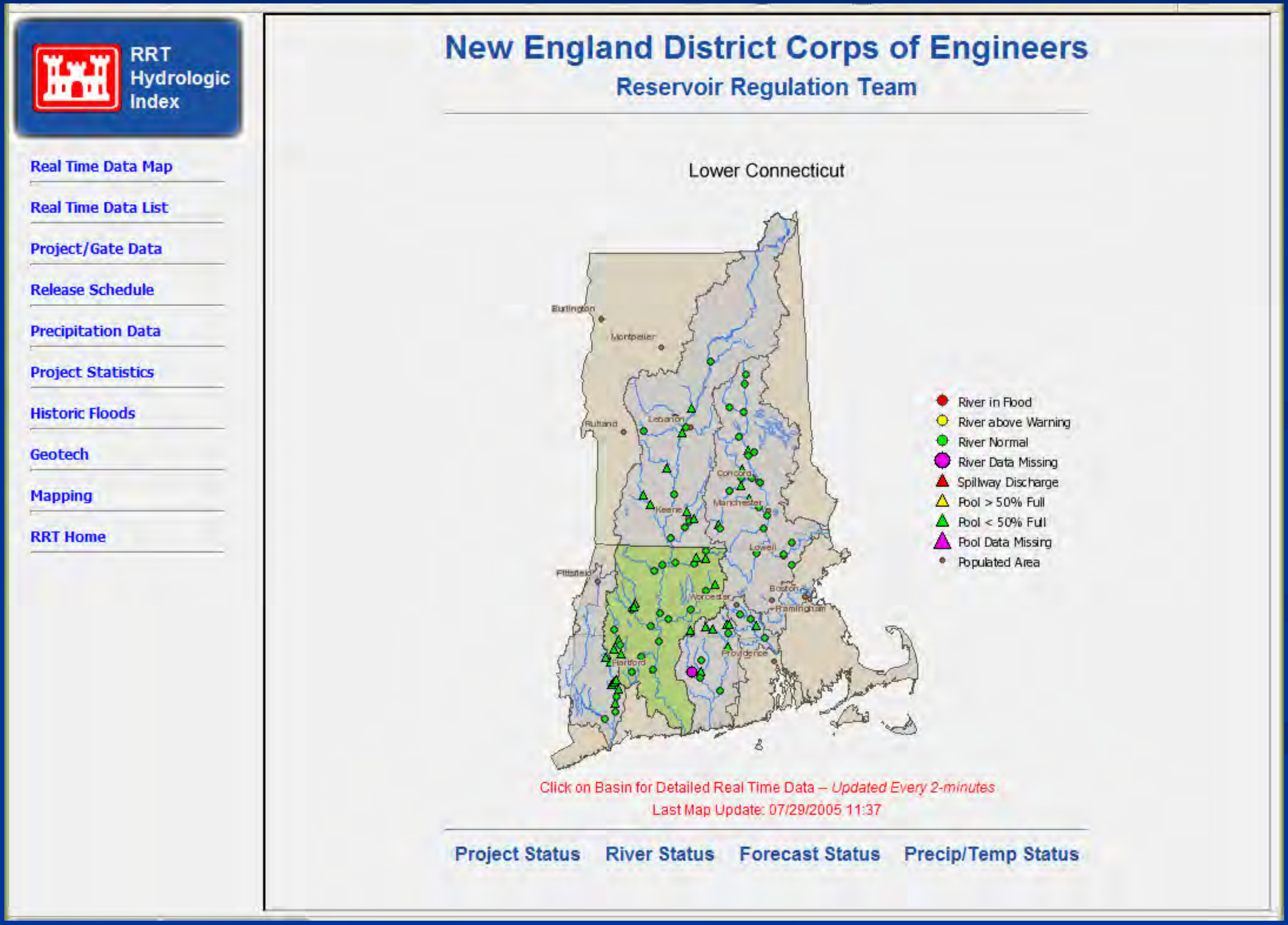
CorpsMap Portal



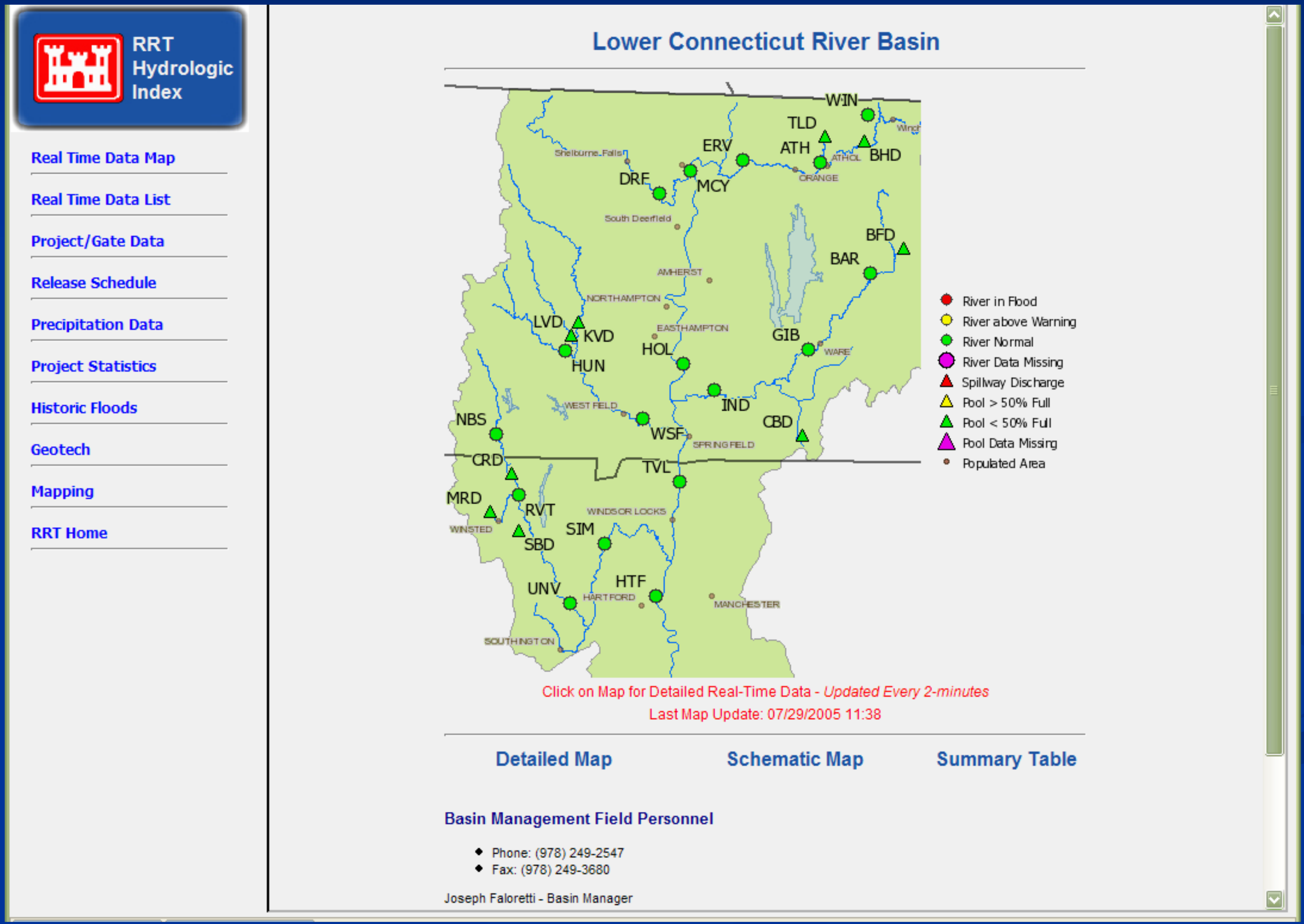
CorpsMap Map Browser



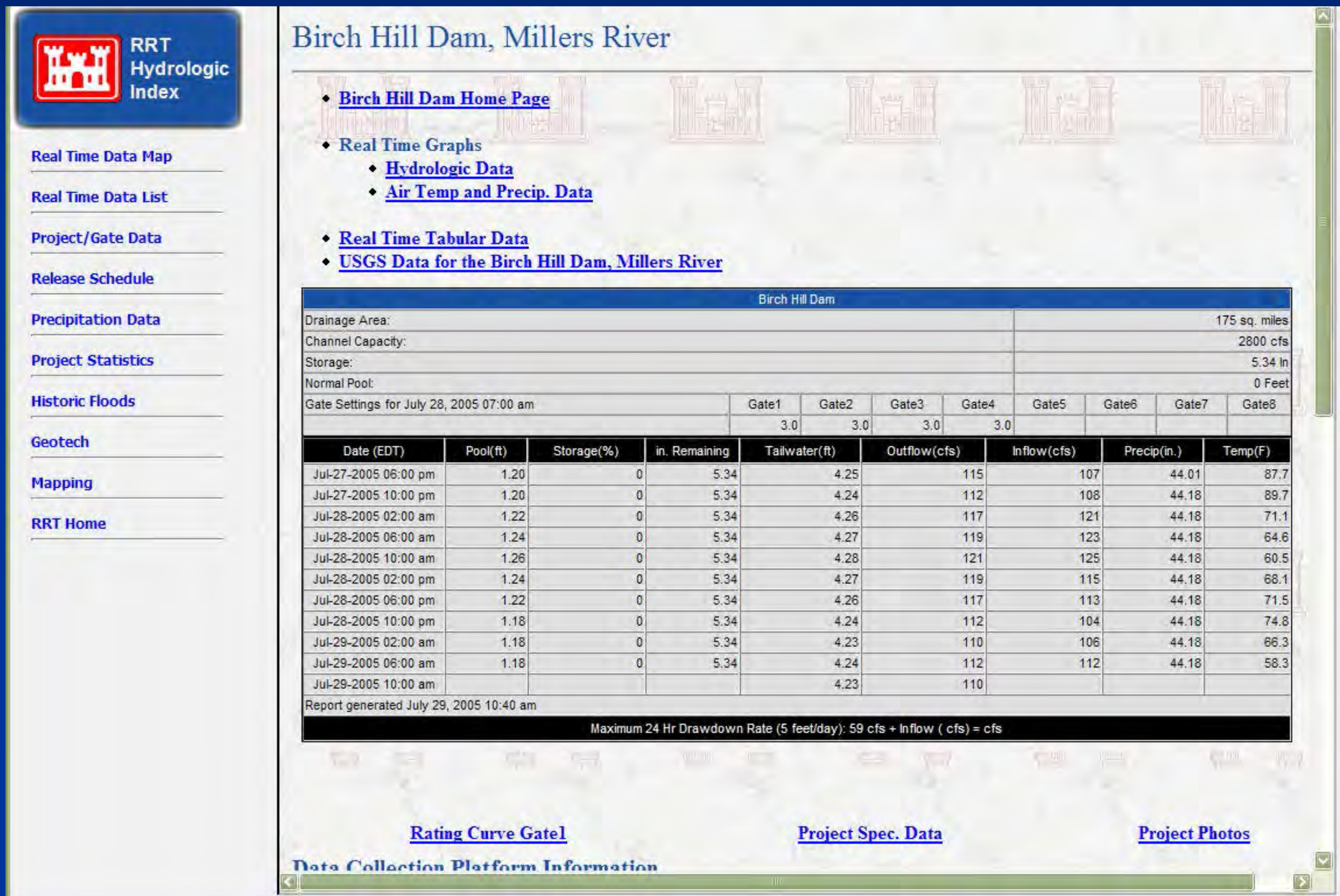
NAE CWMS Oracle-driven Web Site / Real-time Data Map



Individual Basin Display of NAE CWMS Web Site



Real-time and Historical CWMS Data Access


RRT Hydrologic Index

- Real Time Data Map
- Real Time Data List
- Project/Gate Data
- Release Schedule
- Precipitation Data
- Project Statistics
- Historic Floods
- Geotech
- Mapping
- RRT Home

Birch Hill Dam, Millers River

- Birch Hill Dam Home Page
- Real Time Graphs
  - Hydrologic Data
  - Air Temp and Precip. Data
- Real Time Tabular Data
- USGS Data for the Birch Hill Dam, Millers River

Birch Hill Dam

Drainage Area:	175 sq. miles
Channel Capacity:	2800 cfs
Storage:	5.34 In
Normal Pool:	0 Feet

Gate Settings for July 28, 2005 07:00 am	Gate1	Gate2	Gate3	Gate4	Gate5	Gate6	Gate7	Gate8
	3.0	3.0	3.0	3.0				

Date (EDT)	Pool(ft)	Storage(%)	in. Remaining	Tailwater(ft)	Outflow(cfs)	Inflow(cfs)	Precip(in.)	Temp(F)
Jul-27-2005 06:00 pm	1.20	0	5.34	4.25	115	107	44.01	87.7
Jul-27-2005 10:00 pm	1.20	0	5.34	4.24	112	108	44.18	89.7
Jul-28-2005 02:00 am	1.22	0	5.34	4.26	117	121	44.18	71.1
Jul-28-2005 06:00 am	1.24	0	5.34	4.27	119	123	44.18	64.6
Jul-28-2005 10:00 am	1.26	0	5.34	4.28	121	125	44.18	60.5
Jul-28-2005 02:00 pm	1.24	0	5.34	4.27	119	115	44.18	68.1
Jul-28-2005 06:00 pm	1.22	0	5.34	4.26	117	113	44.18	71.5
Jul-28-2005 10:00 pm	1.18	0	5.34	4.24	112	104	44.18	74.8
Jul-29-2005 02:00 am	1.18	0	5.34	4.23	110	106	44.18	66.3
Jul-29-2005 06:00 am	1.18	0	5.34	4.24	112	112	44.18	58.3
Jul-29-2005 10:00 am				4.23	110			

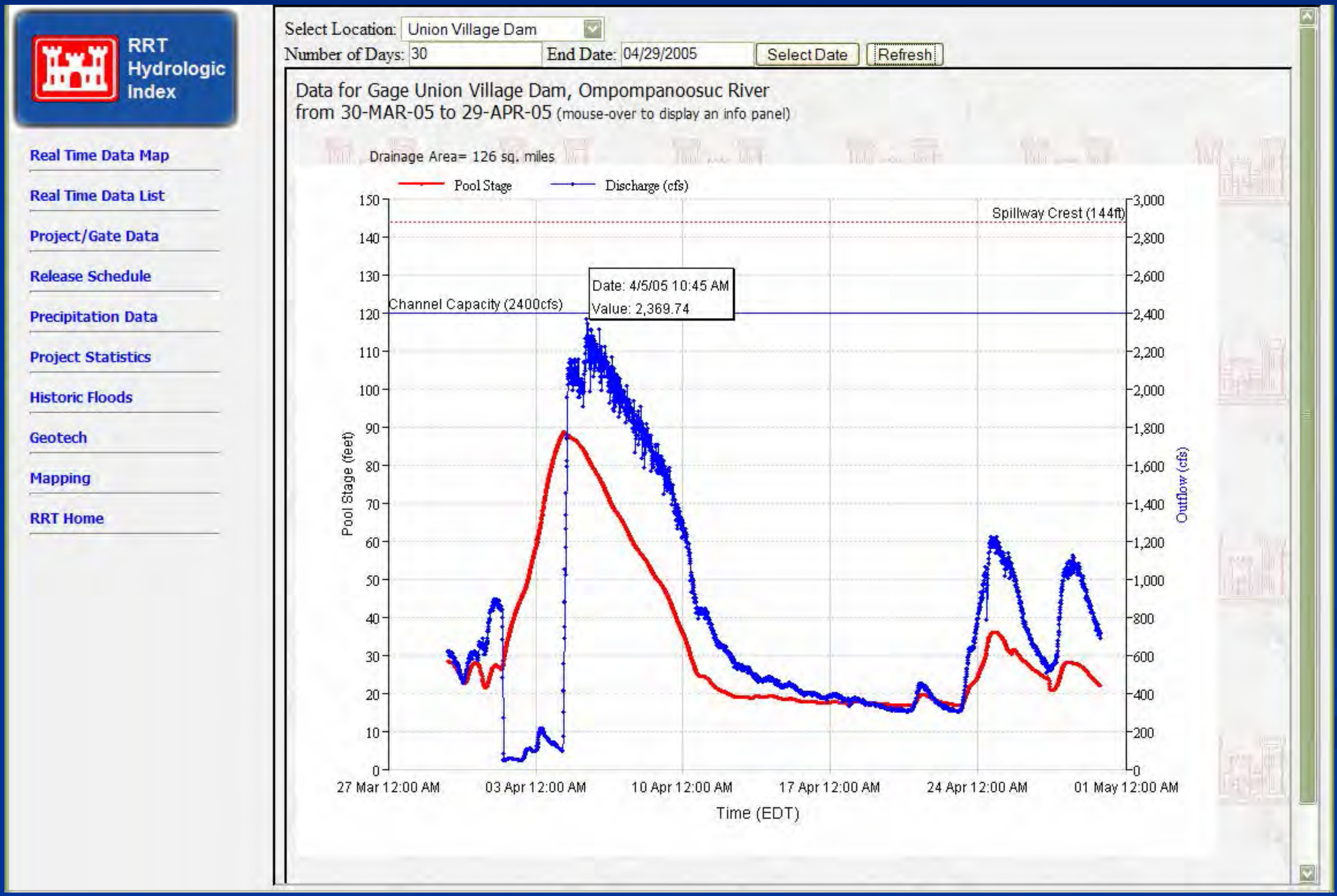
Report generated July 29, 2005 10:40 am

Maximum 24 Hr Drawdown Rate (5 feet/day): 59 cfs + Inflow (cfs) = cfs

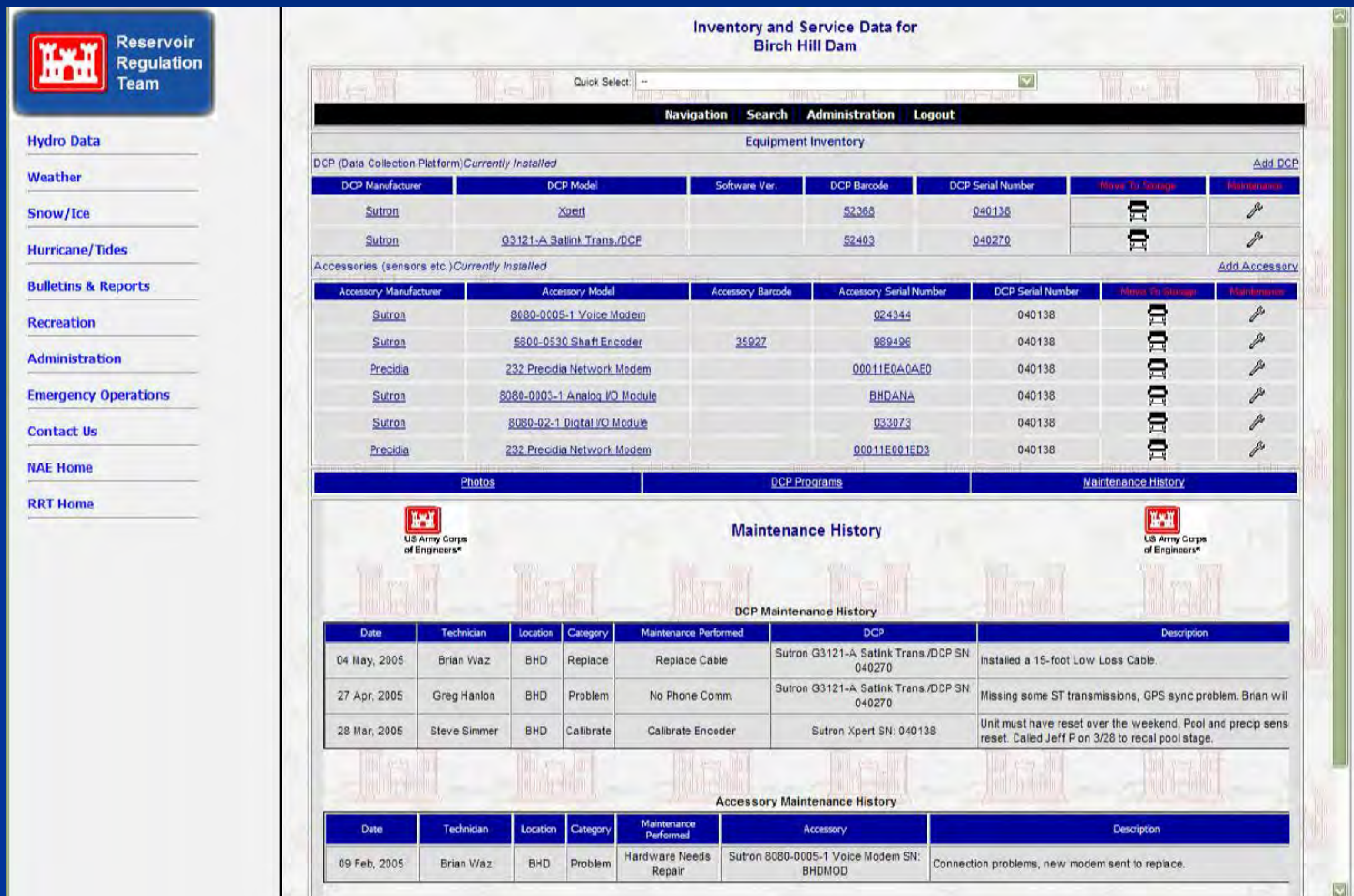
Rating Curve Gate1 | Project Spec. Data | Project Photos

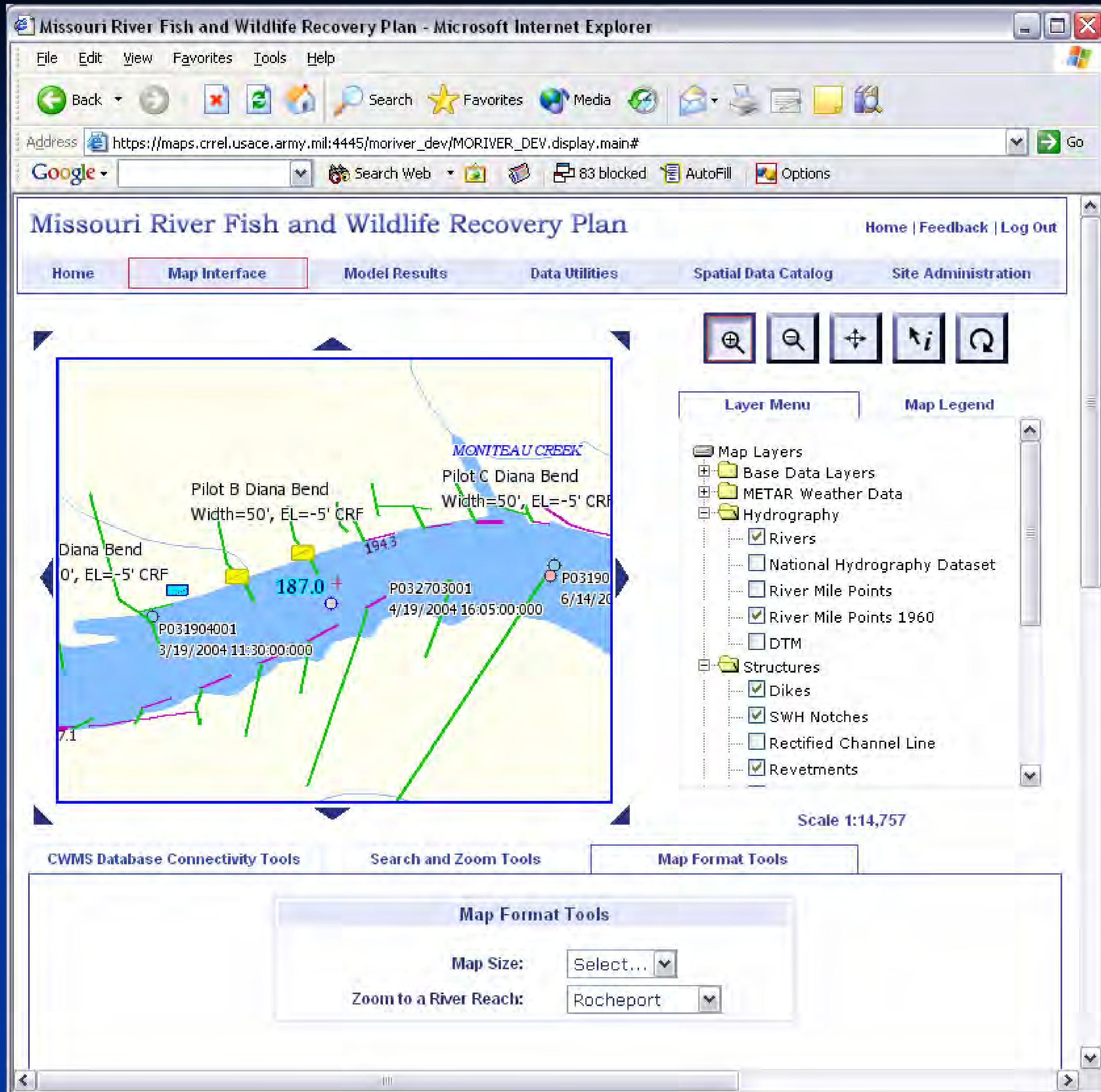
Data Collection Platform Information

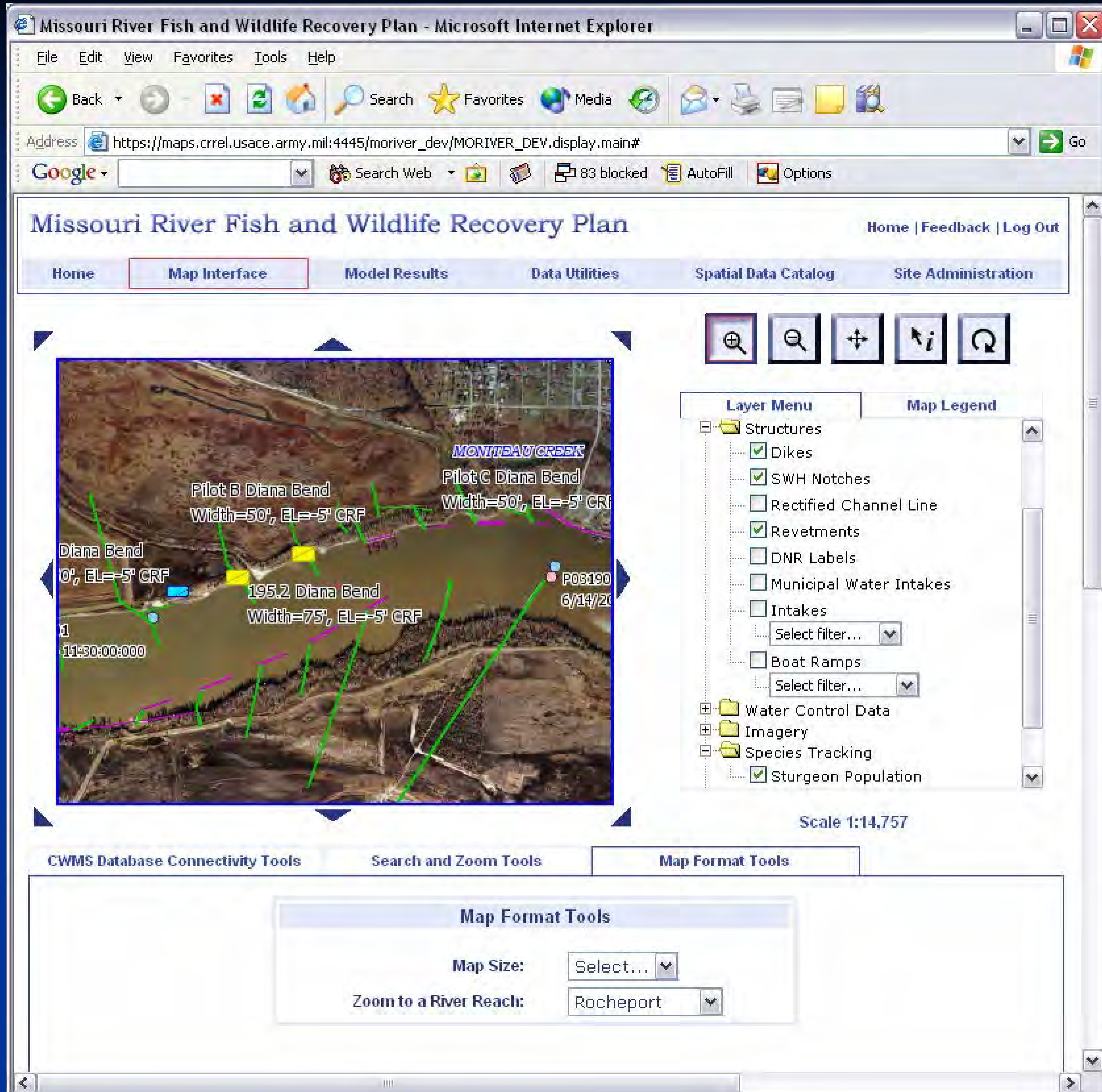
Historical CWMS Data Plotting



Gage Management Utility – Maintenance History for Every Site




Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address https://maps.crrel.usace.army.mil:4445/moriver_dev/MORIVER_DEV.display.main#
Go
Google Search Web 83 blocked AutoFill Options
Missouri River Fish and Wildlife Recovery Plan
Home | Feedback | Log Out
Home
Map Interface
Model Results
Data Utilities
Spatial Data Catalog
Site Administration
MONITEAU CREEK
Pilot C Diana Bend
Width=50', EL=-5' CRF
Pilot B Diana Bend
Width=50', EL=-5' CRF
Diana Bend
0', EL=-5' CRF
187.0
P032703001
4/19/2004 16:05:00:000
P031904001
3/19/2004 11:30:00:000
Layer Menu
Map Legend
Map Layers
Base Data Layers
METAR Weather Data
Hydrography
Rivers
National Hydrography Dataset
River Mile Points
River Mile Points 1960
DTM
Structures
Dikes
SWH Notches
Rectified Channel Line
Revetments
Scale 1:14,757
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
Map Format Tools
Map Size:
Select...
Zoom to a River Reach:
Rocheport


Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
File Edit View Favorites Tools Help
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Search
Favorites
Media
Address
https://maps.crrel.usace.army.mil:4445/moriver_dev/MORIVER_DEV.display.main#
Go
Google
Search Web
83 blocked
AutoFill
Options
Missouri River Fish and Wildlife Recovery Plan
Home | Feedback | Log Out
Home
Map Interface
Model Results
Data Utilities
Spatial Data Catalog
Site Administration
MONITEAU CREEK
Pilot B Diana Bend
Width=50', EL=-5' CRF
Pilot C Diana Bend
Width=50', EL=-5' CRF
Diana Bend
0', EL=-5' CRF
195.2 Diana Bend
Width=75', EL=-5' CRF
11:30:00:000
P03190
6/14/20
Layer Menu
Map Legend
Structures
Dikes
SWH Notches
Rectified Channel Line
Revetments
DNR Labels
Municipal Water Intakes
Intakes
Select filter...
Boat Ramps
Select filter...
Water Control Data
Imagery
Species Tracking
Sturgeon Population
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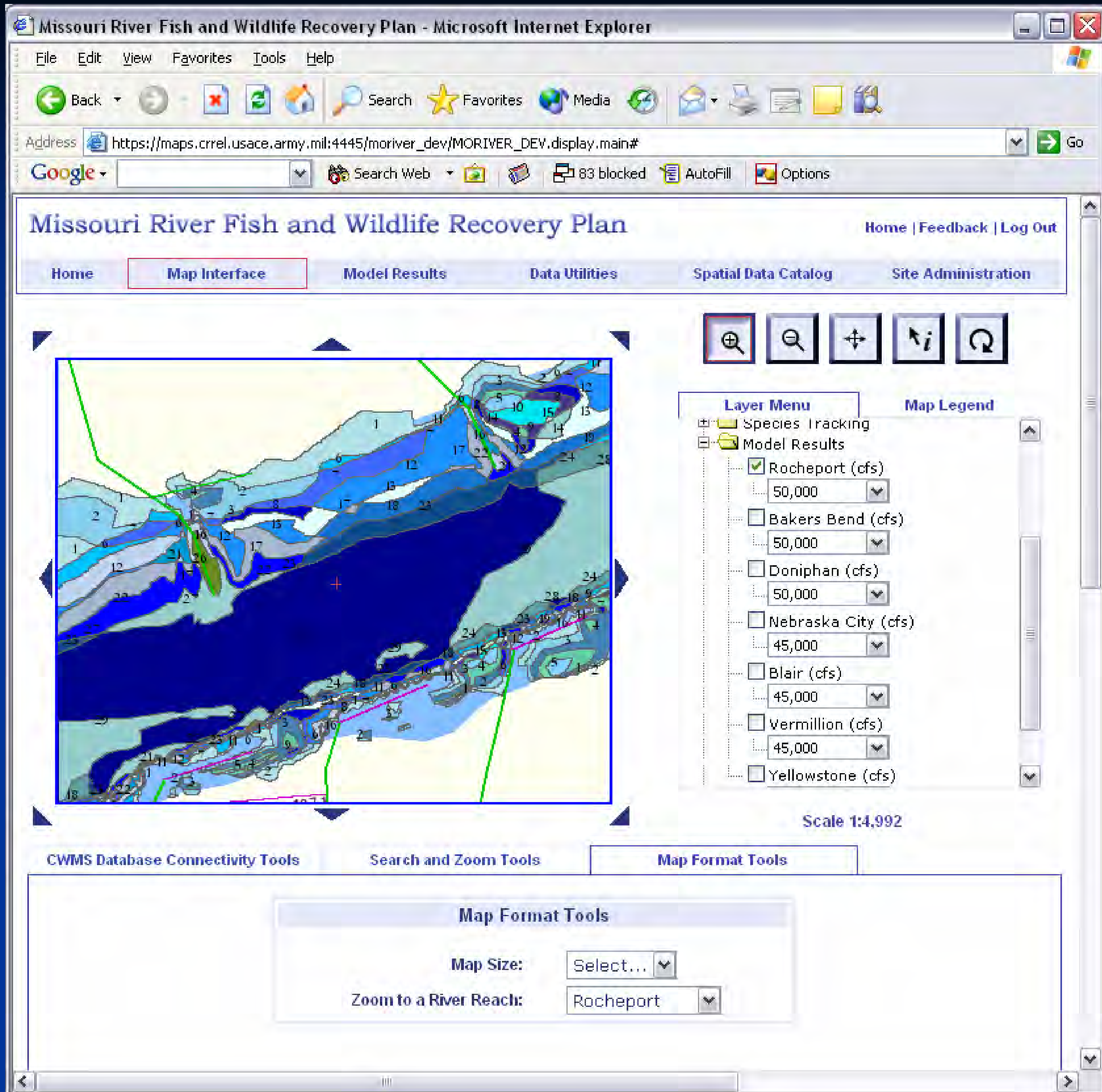
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
Map Format Tools
Map Size:
Select...
Zoom to a River Reach:
Rocheport


Missouri River Fish and Wildlife Recovery Plan - Microsoft Internet Explorer
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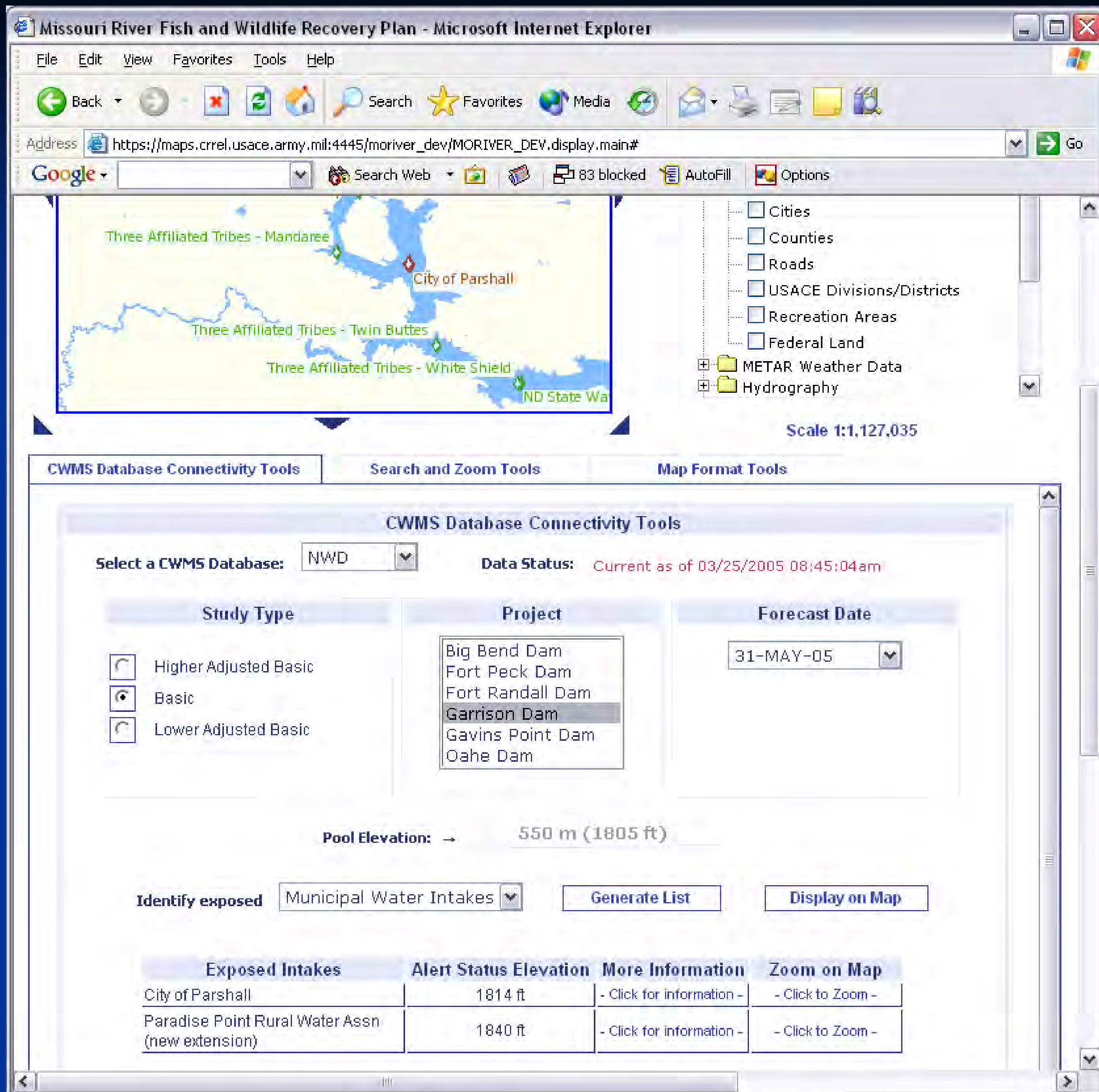
Address https://maps.crrel.usace.army.mil:4445/moriver_dev/MORIVER_DEV.display.main#
Go
Google Search Web 83 blocked AutoFill Options
Missouri River Fish and Wildlife Recovery Plan
Home | Feedback | Log Out
Home
Map Interface
Model Results
Data Utilities
Spatial Data Catalog
Site Administration
Layer Menu
Map Legend
Species Tracking
Model Results
Rocheport (cfs)
50,000
Bakers Bend (cfs)
50,000
Doniphan (cfs)
50,000
Nebraska City (cfs)
45,000
Blair (cfs)
45,000
Vermillion (cfs)
45,000
Yellowstone (cfs)
Scale 1:4,992
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
Map Format Tools
Map Size:
Select...
Zoom to a River Reach:
Rocheport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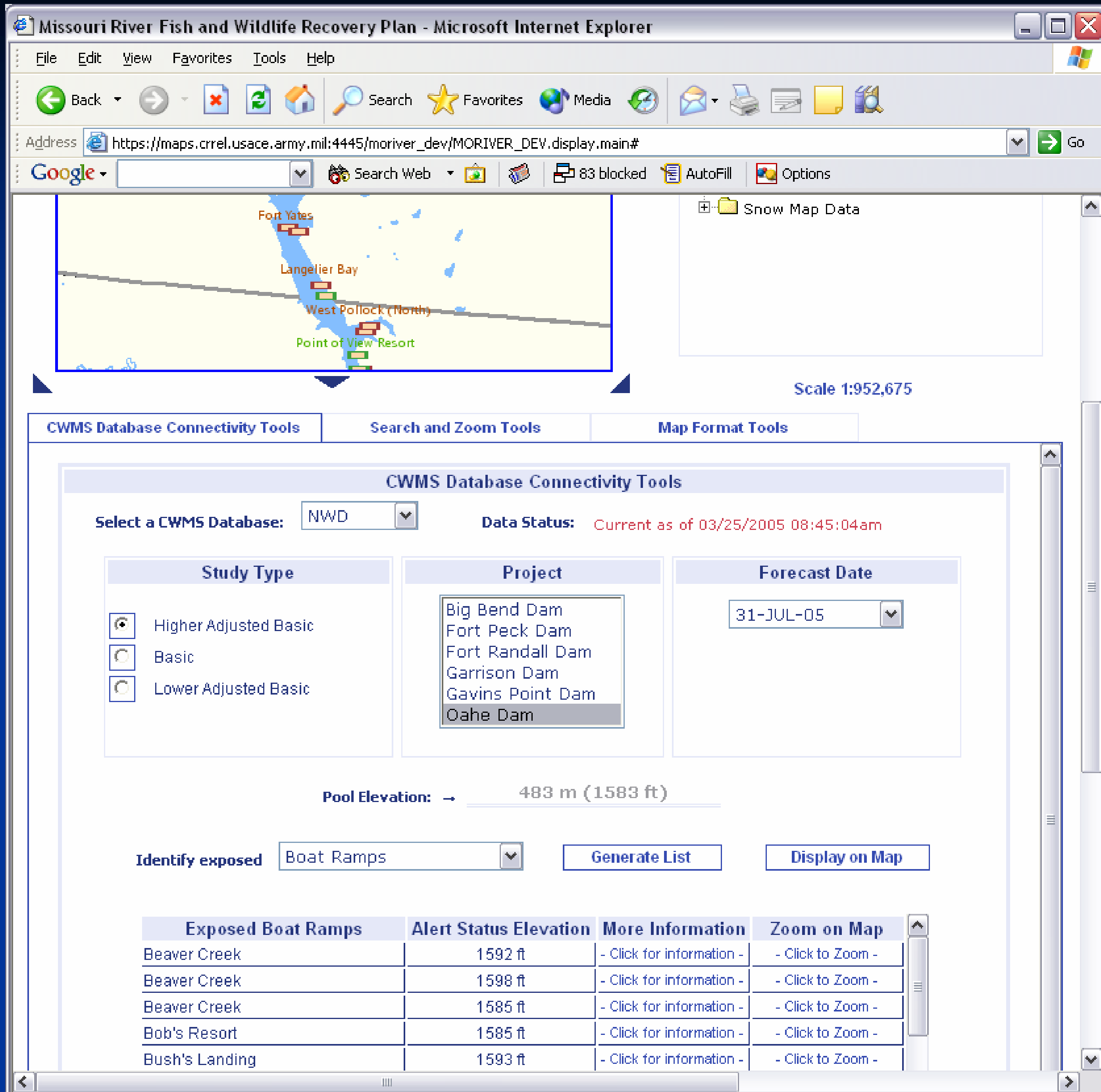
Go
Google Search Web 83 blocked AutoFill Options
Three Affiliated Tribes - Mandaree
City of Parshall
Three Affiliated Tribes - Twin Buttes
Three Affiliated Tribes - White Shield
ND State Wa
Cities
Counties
Roads
USACE Divisions/Districts
Recreation Areas
Federal Land
METAR Weather Data
Hydrography
Scale 1:1,127,035
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
CWMS Database Connectivity Tools
Select a CWMS Database: NWD
Data Status: Current as of 03/25/2005 08:45:04am
Study Type
Higher Adjusted Basic
Basic
Lower Adjusted Basic
Project
Big Bend Dam
Fort Peck Dam
Fort Randall Dam
Garrison Dam
Gavins Point Dam
Oahe Dam
Forecast Date
31-MAY-05
Pool Elevation: →
550 m (1805 ft)
Identify exposed Municipal Water Intakes
Generate List
Display on Map
Exposed Intakes
Alert Status Elevation
More Information
Zoom on Map
City of Parshall
1814 ft
- Click for information -
- Click to Zoom -
Paradise Point Rural Water Assn (new extension)
1840 ft
- Click for information -
- Click to Zoom -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Favorites
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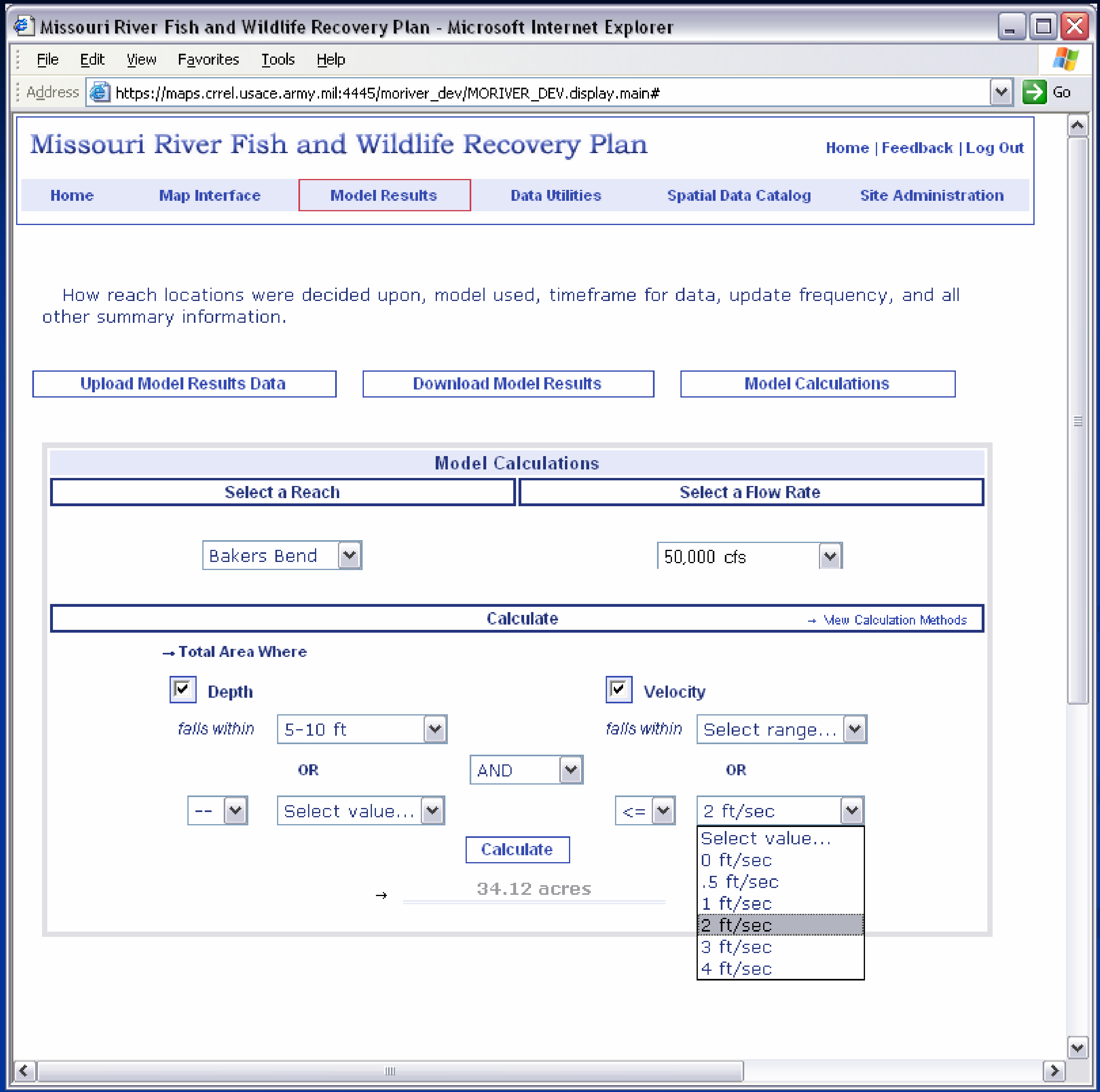
https://maps.crrel.usace.army.mil:4445/moriver_dev/MORIVER_DEV.display.main#
Go
Google
Search Web
83 blocked
AutoFill
Options
Fort Yates
Langelier Bay
West Pollock (North)
Point of View Resort
Snow Map Data
Scale 1:952,675
CWMS Database Connectivity Tools
Search and Zoom Tools
Map Format Tools
CWMS Database Connectivity Tools
Select a CWMS Database:
NWD
Data Status:
Current as of 03/25/2005 08:45:04am
Study Type
Higher Adjusted Basic
Basic
Lower Adjusted Basic
Project
Big Bend Dam
Fort Peck Dam
Fort Randall Dam
Garrison Dam
Gavins Point Dam
Oahe Dam
Forecast Date
31-JUL-05
Pool Elevation:
483 m (1583 ft)
Identify exposed
Boat Ramps
Generate List
Display on Map
Exposed Boat Ramps
Alert Status Elevation
More Information
Zoom on Map
Beaver Creek
1592 ft
- Click for information -
- Click to Zoom -
Beaver Creek
1598 ft
- Click for information -
- Click to Zoom -
Beaver Creek
1585 ft
- Click for information -
- Click to Zoom -
Bob's Resort
1585 ft
- Click for information -
- Click to Zoom -
Bush's Landing
1593 ft
- Click for information -
- Click to Zoom -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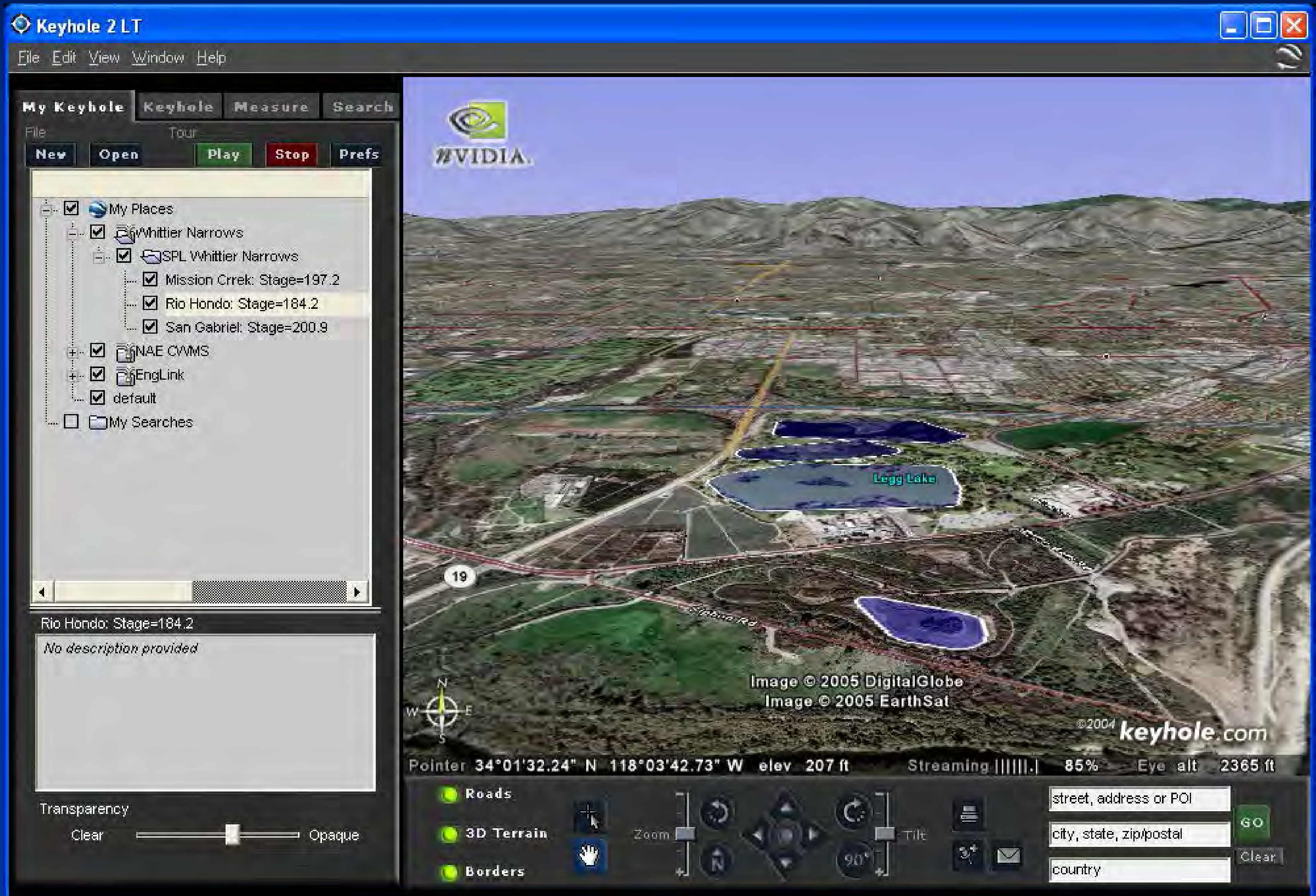
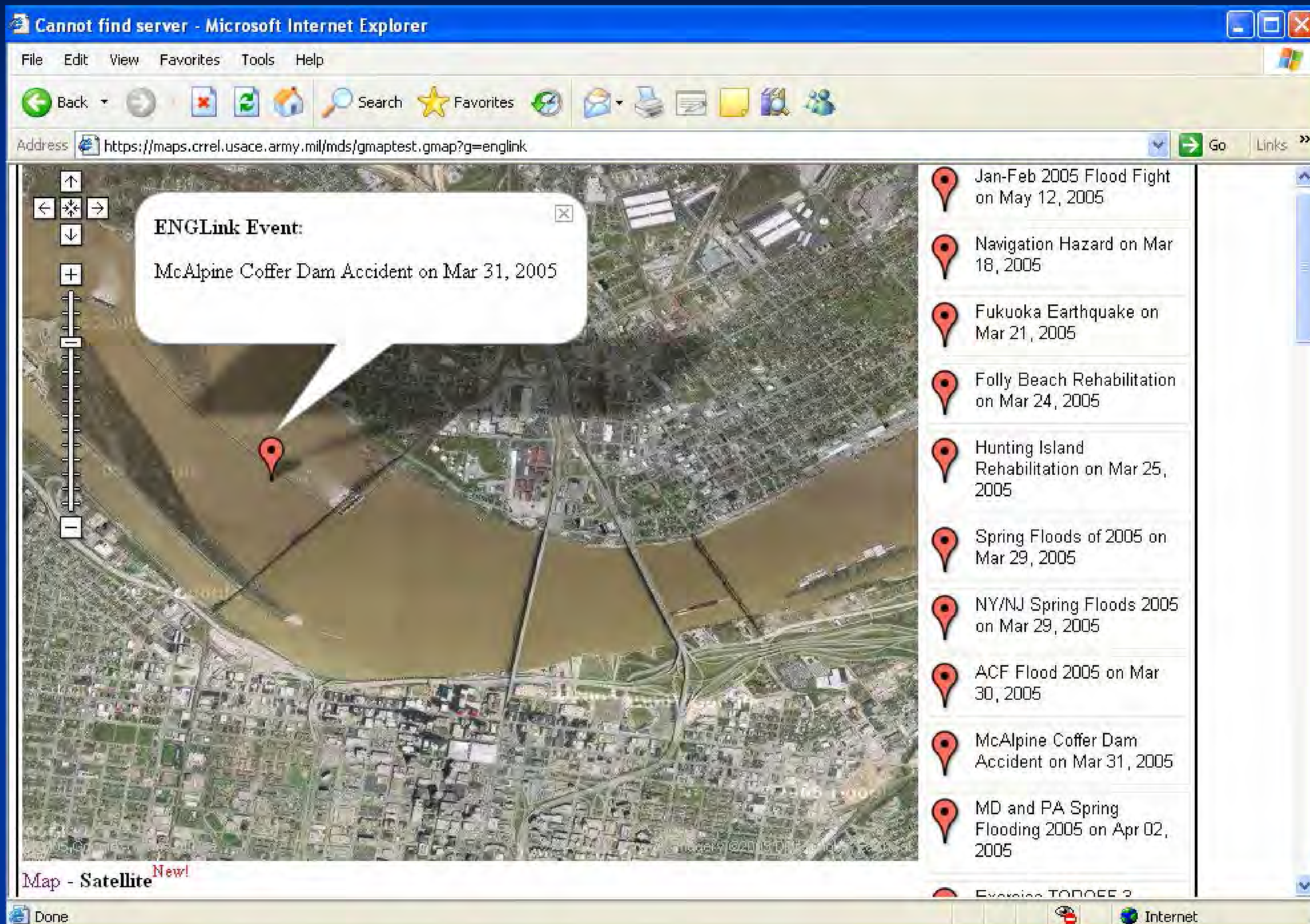
Go
Missouri River Fish and Wildlife Recovery Plan
Home | Feedback | Log Out
Home
Map Interface
Model Results
Data Utilities
Spatial Data Catalog
Site Administration
How reach locations were decided upon, model used, timeframe for data, update frequency, and all other summary information.
Upload Model Results Data
Download Model Results
Model Calculations
Model Calculations
Select a Reach
Select a Flow Rate
Bakers Bend
50,000 cfs
Calculate
→ View Calculation Methods
→ Total Area Where
Depth
Velocity
falls within
5-10 ft
falls within
Select range...
OR
AND
OR
--
Select value...
<=
2 ft/sec
Select value...
0 ft/sec
.5 ft/sec
1 ft/sec
2 ft/sec
3 ft/sec
4 ft/sec
Calculate
→ 34.12 acres

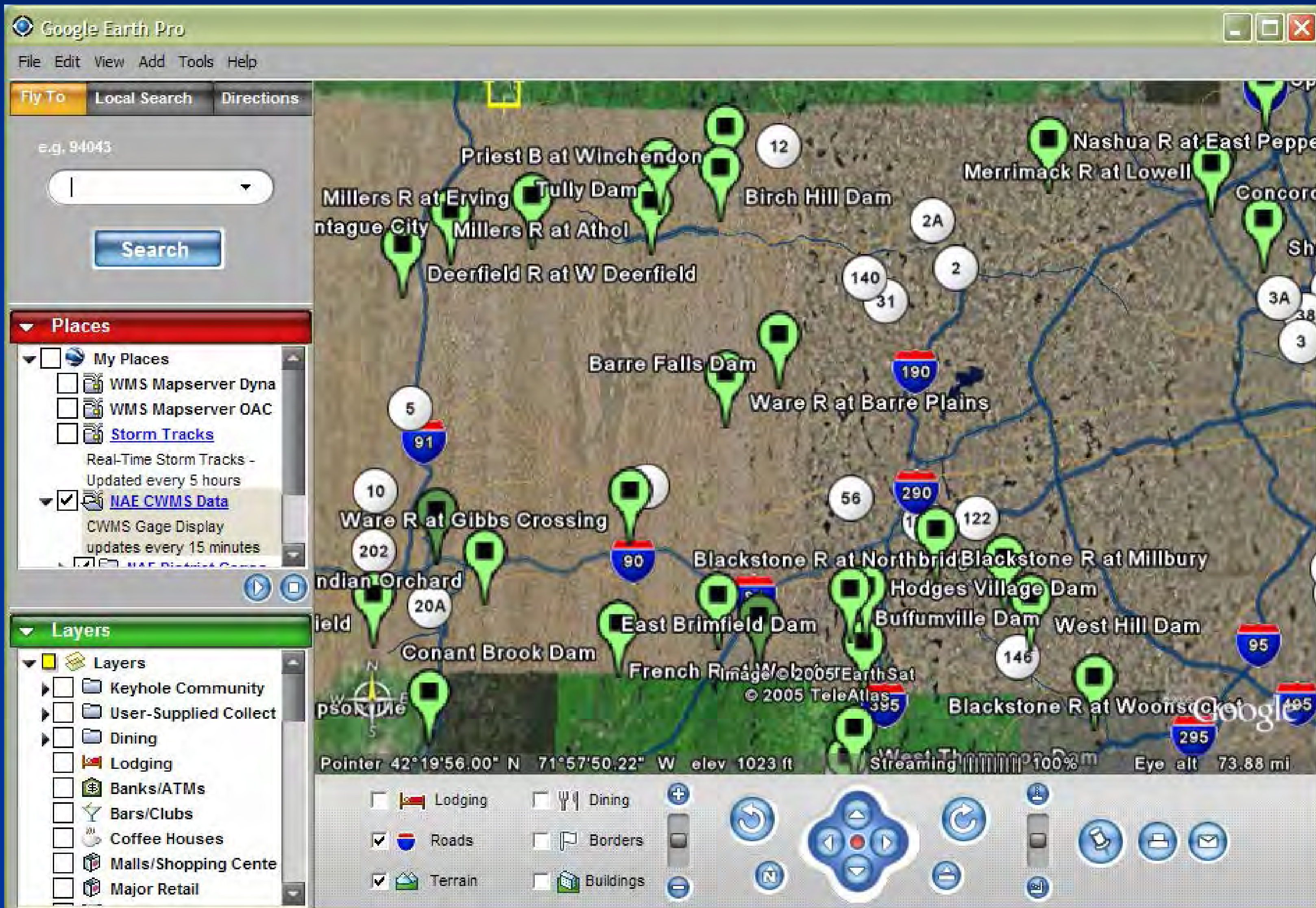
"Transforms The Web:" RS/GIS Absorbs



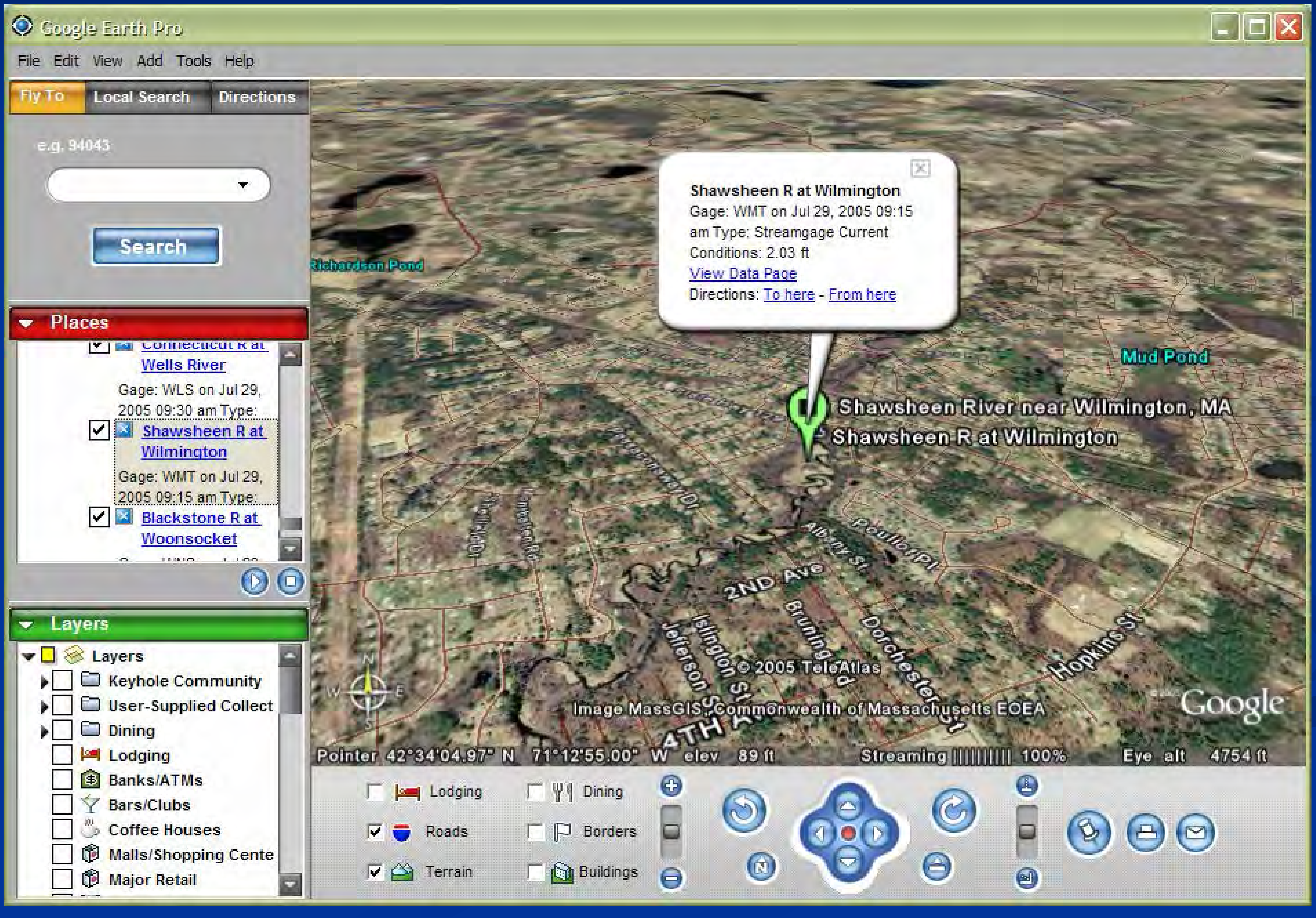
CorpsMap/EngLink – BYO BaseMap



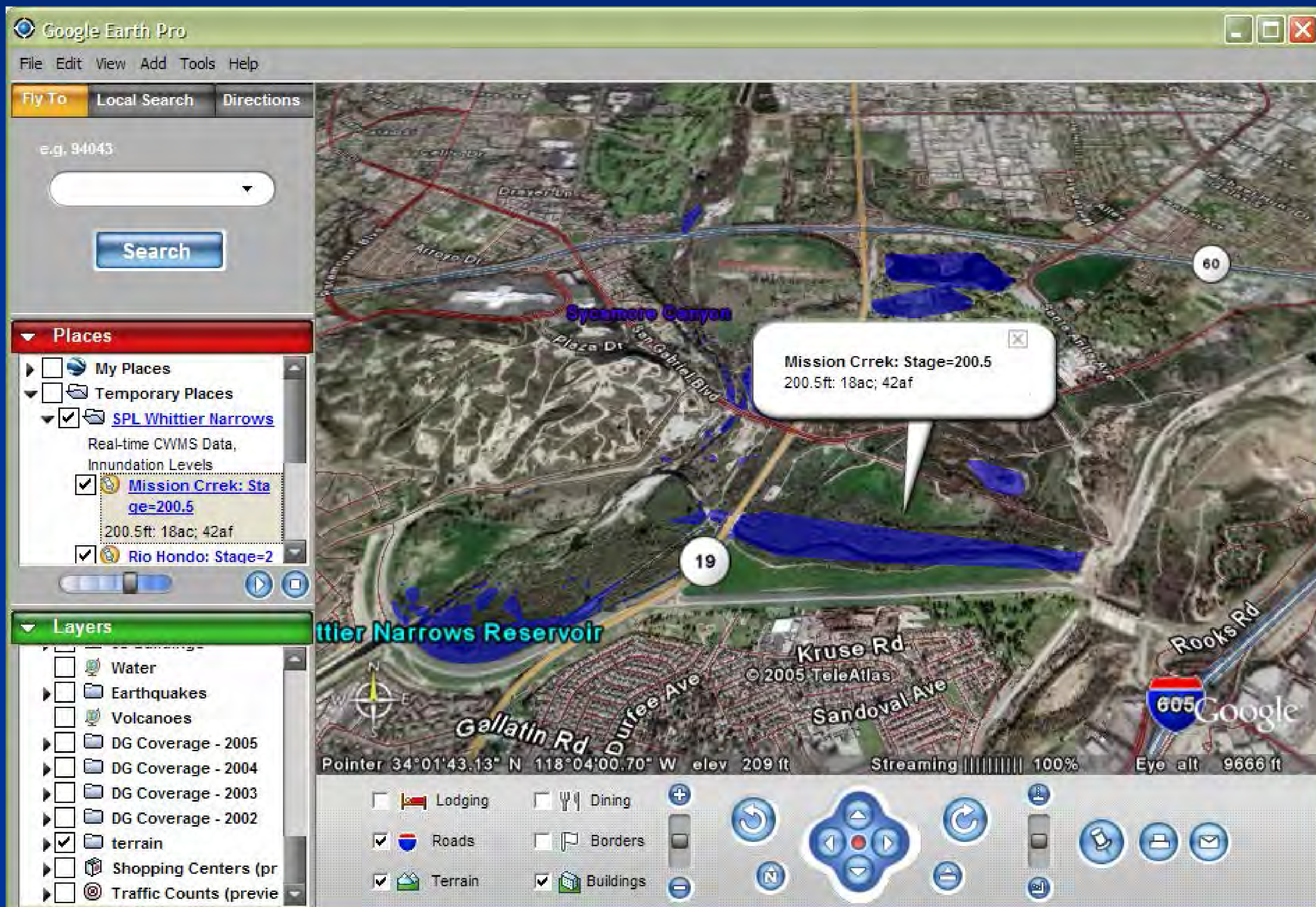
NAE CWMS Stations Mapped via Google Earth



Detail View of NAE CWMS Gage on Google Earth



Whittier Narrows Visualization at Higher Stage Levels



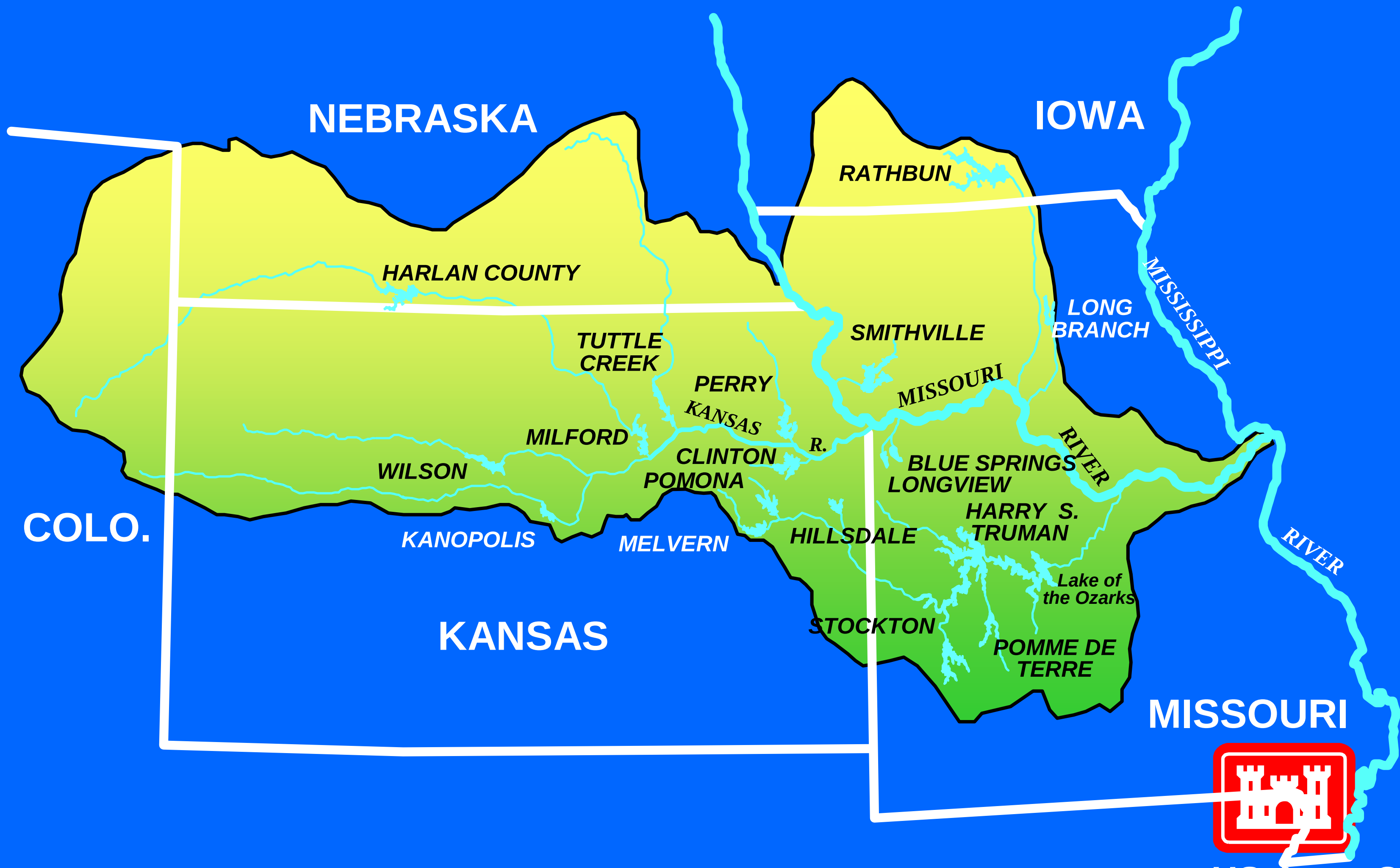
Comments/Questions?

Kansas River Basin Model

Edward Parker, P.E.

US Army Corps of Engineers
Kansas City District

KANSAS CITY DISTRICT



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Kansas River Basin Operation Challenges

- Protect nesting Least Terns and Piping Plovers that have taken residence along the Kansas River.
- Supply navigation water support for the Missouri River.
- Reviewing requests from the State of Kansas and the USBR to alter the standard operation to improve support for recreation, irrigation, fish & wildlife.

US Army Corps of Engineers
Kansas City District

Model Requirements

- Model Period 1/1/1920 through 12/31/2000
- Six-Hour routing period
- Forecast local inflow using recession
- Use historic pan evaporation
  - Monthly vary pan coefficient
- Parallel and tandem operation
- Consider all authorized puposes
- Use current method of flood control

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Kansas City District

Model PMP Revisions

- Model period from 1/1/1929 through 12/30/2001
- Mean daily flows for modeling rather than 6-hour data derived from mean daily flow values.
- Delete the requirement to forecast future hydrologic conditions.
- Average monthly lake evaporation rather than daily
- Utilize a standard pan evaporation coefficient of 0.7 rather than a monthly varying value.
- Separate the study basin between the Smoky River Basin and the Republican/Kansas River Basin.

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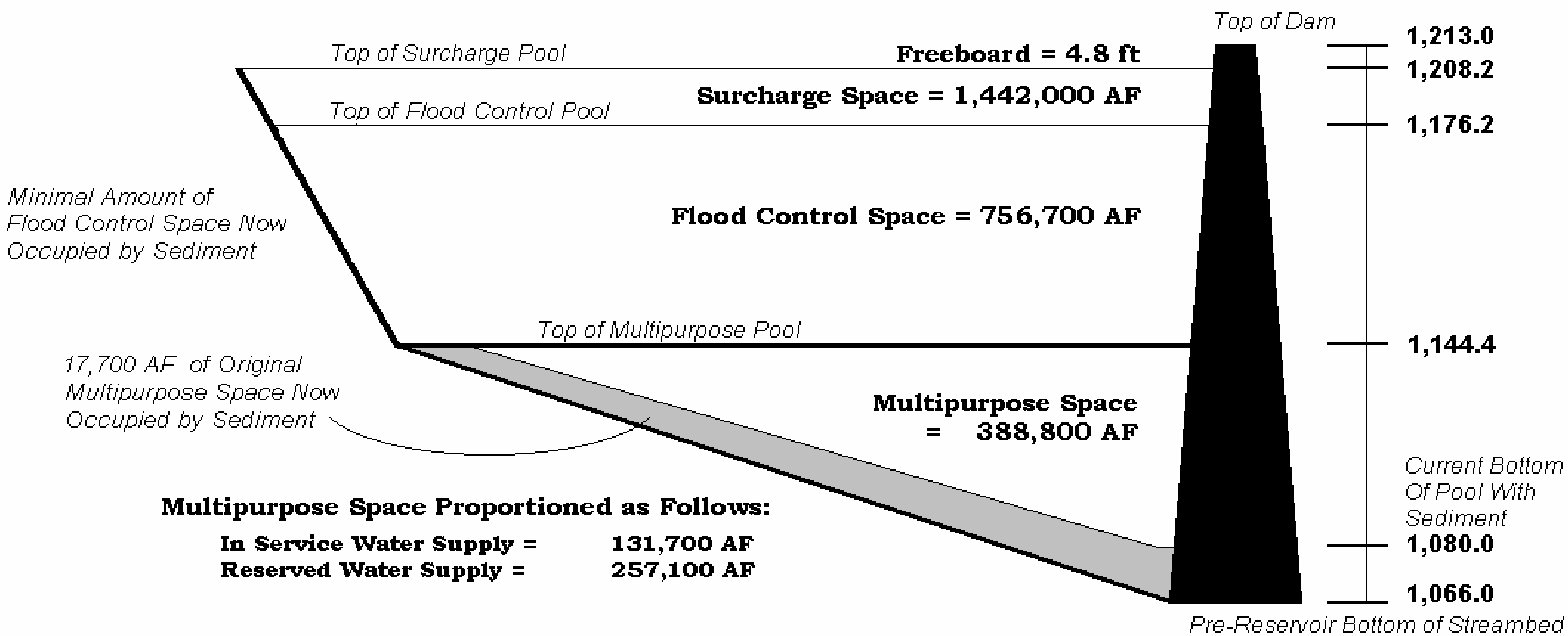
Kansas River Basin

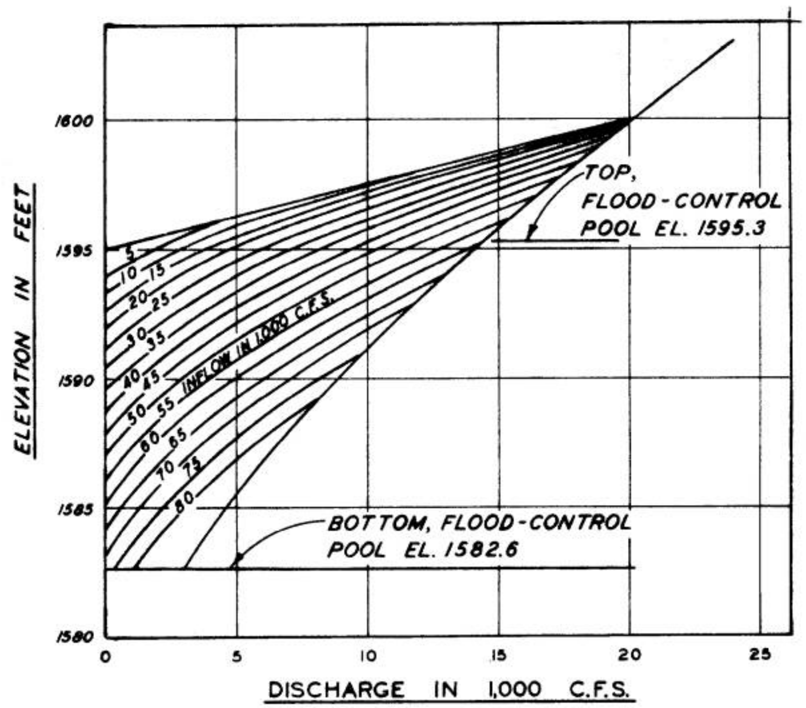
Milford Lake
Current Storage Allocations

As of Last Sediment Survey in 1980



Storage Allocations	At Closure (1964)	Current	At End of Design Life
Flood Control	754,800 AF	756,700 AF	700,000 AF
Multipurpose	406,500 AF		
Water Supply			
In Service		131,700 AF	101,650 AF
Reserved		257,100 AF	198,350 AF

CORPS OF ENGINEERS U. S. ARMY



NOTE: THE DATA ON THIS CHART ARE FOR USE OF AUTHORIZED PERSONNEL OF THE WATER CONTROL SECTION OF THE KANSAS CITY DISTRICT. WHEN THE RESERVOIR IS ABOVE ELEVATION 1582.6, SPILLWAY GATES WILL BE OPENED UNIFORMLY, INSOFAR AS POSSIBLE, IN ACCORDANCE WITH THIS PLATE.

DURING RISING RESERVOIR STAGES, ADJUST THE OUTFLOW EACH HOUR AS INDICATED HEREON ON THE BASIS OF THE CURRENT RESERVOIR ELEVATION AND THE COMPUTED AVERAGE RATE OF INFLOW DURING THE PAST 3 HOURS OR THE PAST HOUR, WHICHEVER IS LESS. IN DETERMINING THE POOL ELEVATIONS, ADJUST FOR WIND EFFECT. SHOULD THE SCHEDULE INDICATE LESS OUTFLOW THAN IS CURRENTLY BEING RELEASED, MAINTAIN THE CURRENT RELEASE AND CONTINUE TO CHECK HOURLY.

WHITE ROCK CREEK BASIN

LOVEWELL RESERVOIR

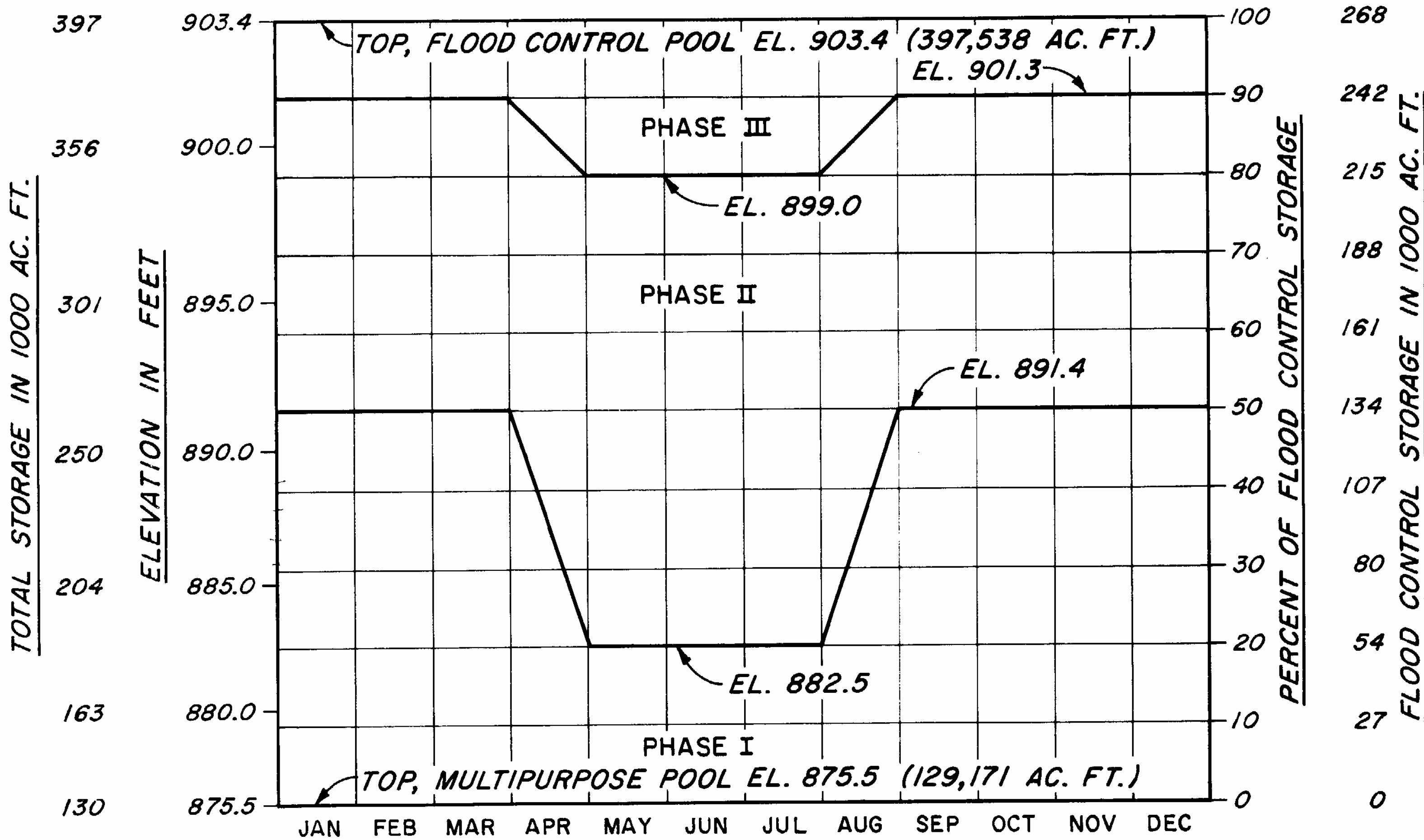
SPILLWAY

OPERATION CRITERIA

FILE NO. B-20-483 FEBRUARY 1987

PLATE NO. 26

US Army Corps of Engineers
Kansas City District



LOWER KANSAS RIVER BASIN

CLINTON LAKE

SEASONAL GUIDELINES

JUNE 1978 FILE NO. A-3-1244

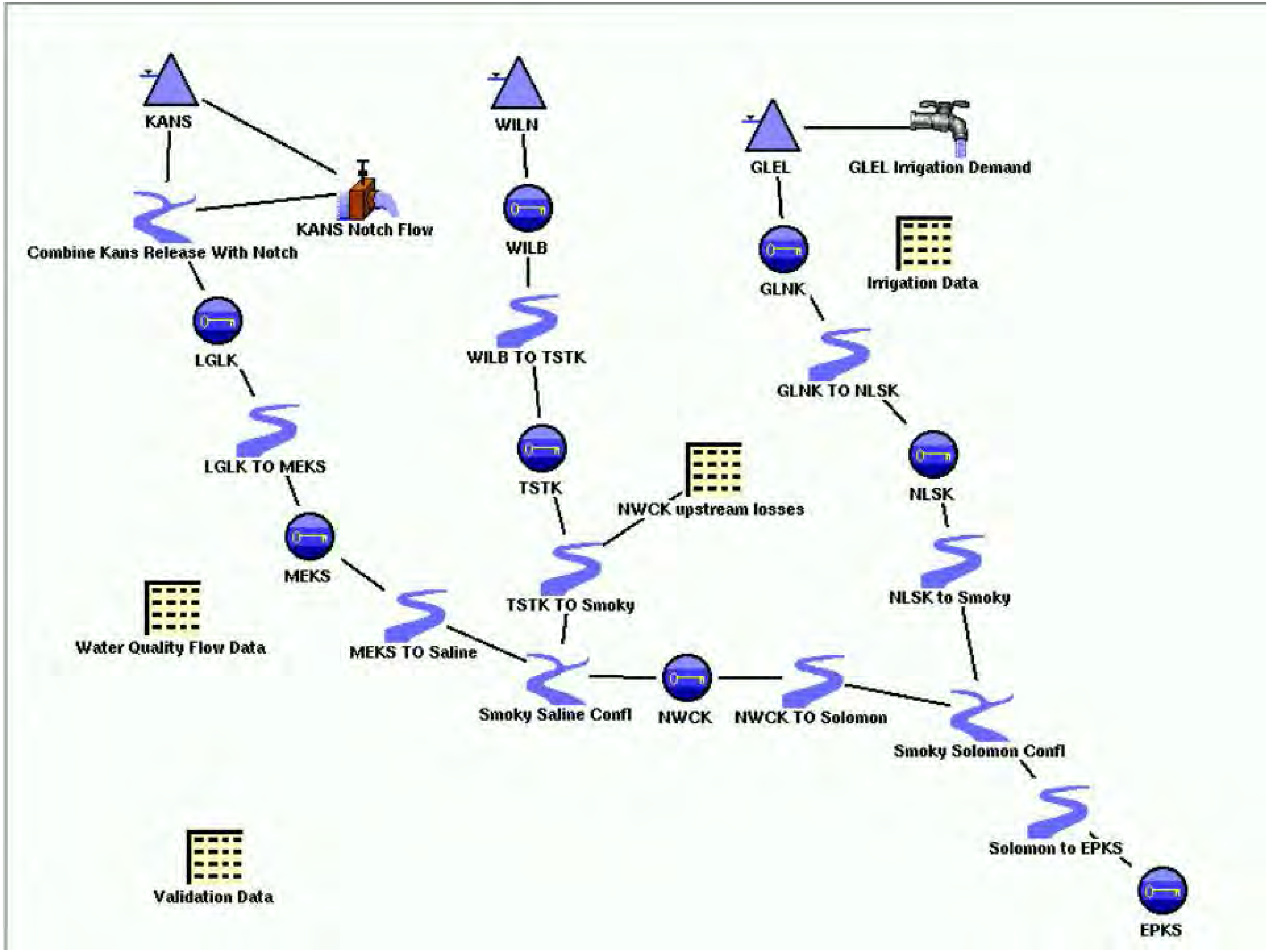
CORPS OF ENGINEERS

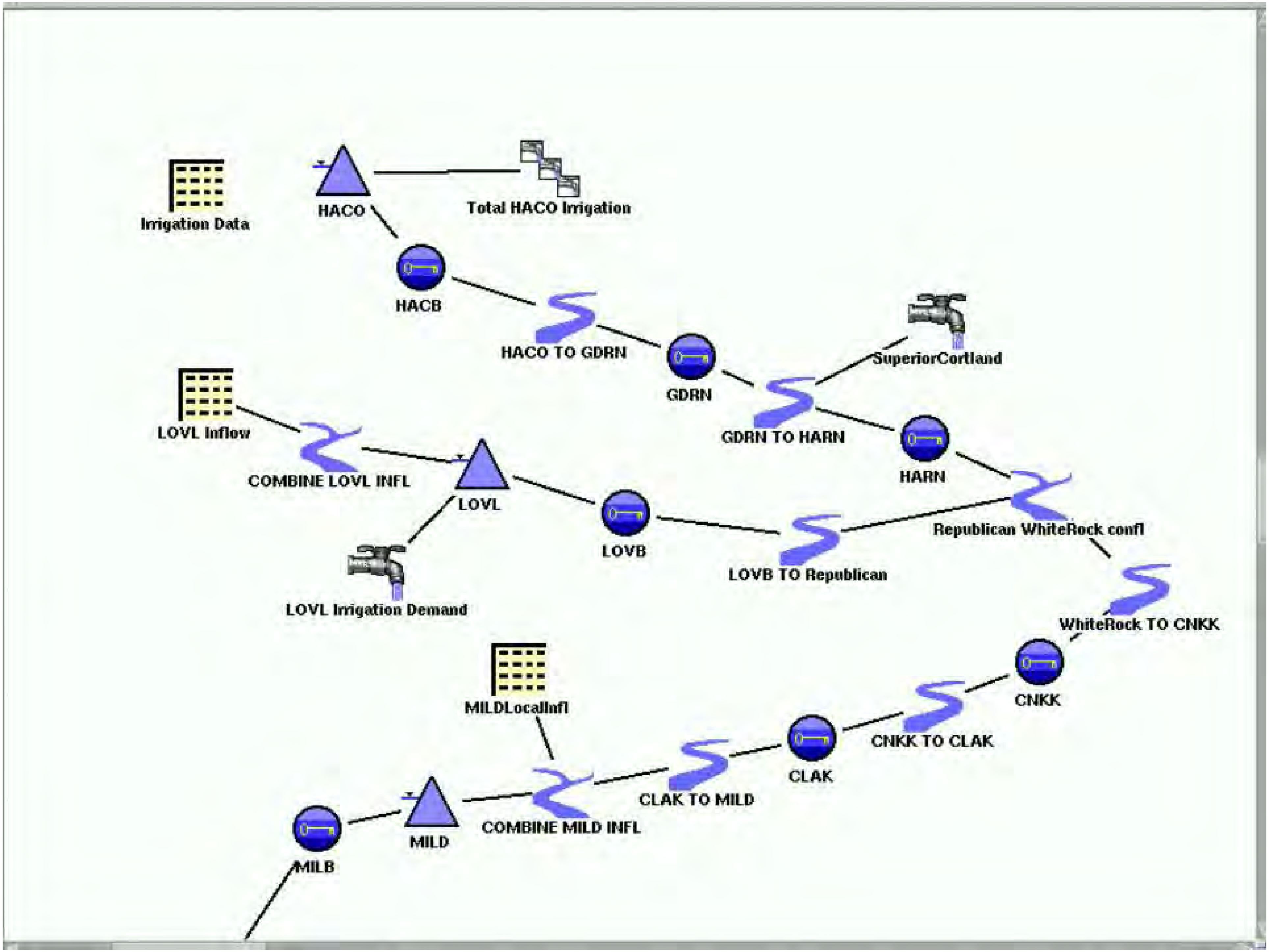
U. S. ARMY

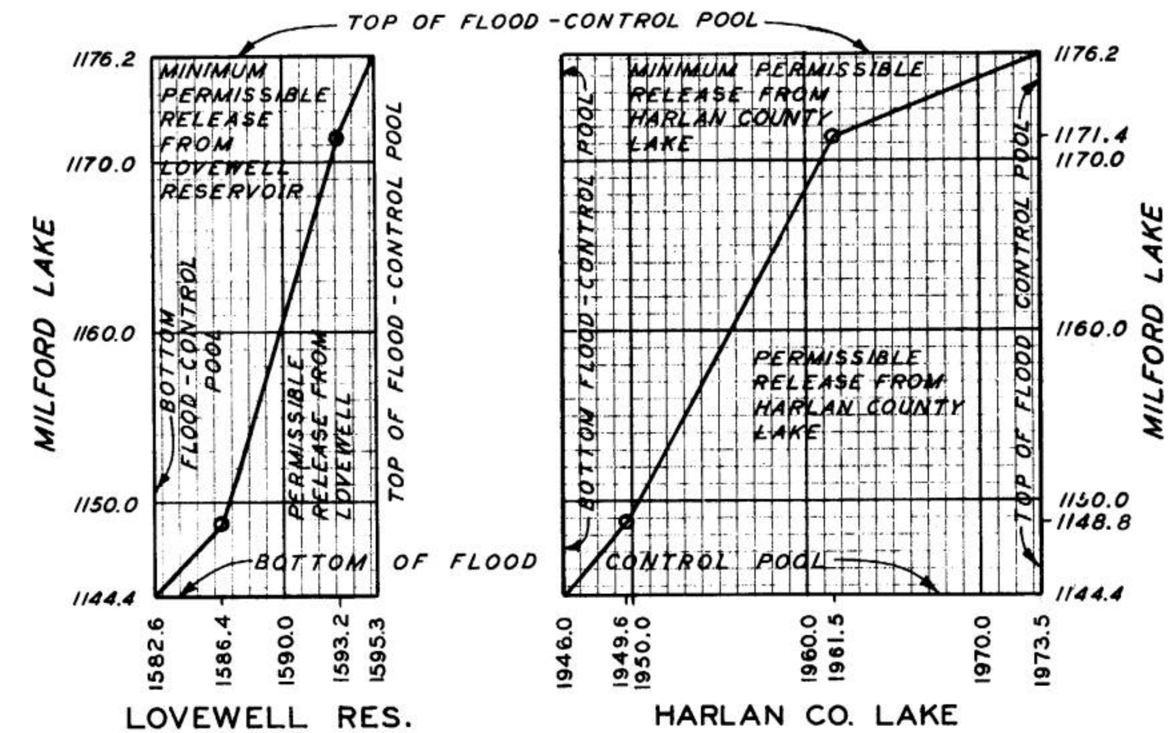
Milford Hydraulic and Regulating Data

Station	River Mile Location	Datum Ft MSL	Gage Flood Stage (ft)	Flood Flow (cfs)	Travel Time (hrs) Average Flow	Dam Break	Regulation Flows (cfs) Phase I	Phase II	Phase III	1993 Flood (cfs) Reg	Unreg
Junction City	(6)	1052.5	22	18,500	3	3	12,000	15,000	22,500	35,000	
Fort Riley	174	1034.7	21	41,000	5	4	27,000	45,000	65,000	87,600	200,000
Wamego	127	950.8	19	67,000	23	11	39,000	65,000	76,000	199,000	258,000
Topeka	83	846.7	26	74,000	41	21	48,000	80,000	90,000	170,000	260,000
Lecompton	64	821.8	17	72,000	49	29	61,000	102,000	120,000	190,000	282,000
Desoto	31	753.8	24	97,000	63	37	66,000	110,000	130,000	170,000	266,000
Kansas City	0 = 366	706.4	32	226,000	77	40	176,000	220,000	240,000	541,000	713,000
Waverly	293	645.5	20	123,000	95		90,000	130,000	180,000	633,000	700,000
Hermann	98	481.4	21	190,000	167		96,000	160,000	190,000	750,000	852,000

All values are preliminary and subject to revision. They were developed for this class and need further checking.


KANS
WILN
GLEL
GLEL Irrigation Demand
KANS Notch Flow
Combine Kans Release With Notch
WILB
GLNK
Irrigation Data
LGLK
WILB TO TSTK
GLNK TO NLSK
LGLK TO MEKS
TSTK
NWCK upstream losses
NLSK
MEKS
TSTK TO Smoky
NLSK to Smoky
Water Quality Flow Data
MEKS TO Saline
Smoky Saline Confl
NWCK
NWCK TO Solomon
Smoky Solomon Confl
Solomon to EPKS
Validation Data
EPKS


Irrigation Data
HACO
Total HACO Irrigation
HACB
HACO TO GDRN
GDRN
SuperiorCortland
LOVL Inflow
GDRN TO HARN
HARN
COMBINE LOVL INFL
LOVL
LOVB
Republican WhiteRock confl
LOVB TO Republican
LOVL Irrigation Demand
WhiteRock TO CNKK
CNKK
MILDLocalInfl
CNKK TO CLAK
CLAK
CLAK TO MILD
COMBINE MILD INFL
MILD
MILB



TANDEM LAKE BALANCE

REPUBLICAN RIVER BASIN

MILFORD LAKE

TANDEM BALANCE

JULY 1971 FILE NO. B-1-1503

CORPS OF ENGINEERS U.S. ARMY

Multipurpose Pool Operation

- Water Supply
  - Lake and River
- Water Quality
  - Mentor, Topeka, DeSoto
- Irrigation
  - Waconda, Harlan County, Lovewell
- Navigation Support
  - Milford, Tuttle Creek, Perry
- Endangered Species
  - Tuttle Creek, Milford
- Recreation & Fish/Wildlife

US Army Corps
of Engineers
Kansas City District


RiverWare
C351-300-021198
Parker Dam

Data Development

- Study period WY 1929 through WY 2002
- Flow Data developed by Dr. Bob Barkau
  - Historic Lake Inflow data used when available
- Daily Actual Water Supply Demand
- Monthly Historic Data
  - Lake Pan Evaporation 1980 through 2002
    - 0.7 Pan Coefficient
  - USBR Irrigation Use
    - Converted to Daily Data
- Daily Rainfall from available gauges
  - Not applied to Historic Lake Inflow
- Reach Geometry from USGS measurements

US Army Corps
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Kansas City District

Historic Lake Inflow

The inflow values from the database begins on the following dates for each lake:

KANS (Kanopolis Lake):	February 18, 1948
HACO (Harlan County Lake):	November 15, 1952
TUCR (Tuttle Creek Lake):	July 22, 1959
WILN (Wilson Lake):	September 4, 1963
PERY (Perry Lake):	August 1, 1966
GLEL (Waconda Lake):	October 18, 1967
CLIN (Clinton Lake):	December 1, 1977
LOVL (Lovewell Reservoir):	January 1, 1980
MILD (Milford Lake)	August 24, 1964

US Army Corps of Engineers
Kansas City District

PRECIPATATION GAGES

HACO:	Phillipsburg 1928 - 1980
LOVL:	Burr Oak 1928 - 1954 Lovewell Dam 1955 - 1980
MILD:	Manhattan 1928 - 1938 Clay Center 1939 - 1947 Junction City 1948 - 1964 Milford Dam 1965 - 1980
TUCR:	Manhattan 1928 – 1980
PERY:	Horton 1928 - 1938 Lawrence 1939 - 1966 Perry Dam 1967 - 1980
CLIN:	Horton 1928 - 1938 Lawrence 1939 - 1976 Clinton Dam 1977 - 1980
KANS:	Ellsworth 1928 - 1947 Kanapolis Dam 1948 - 1980
WILN:	Ellsworth 1928 - 1938 Lincoln 1939 - 1963 Wilson Dam 1964 - 1980
GLEL:	Burr Oak 1928 - 1938 Lincoln 1939 - 1964 Waconda Lake 1964 - 1980

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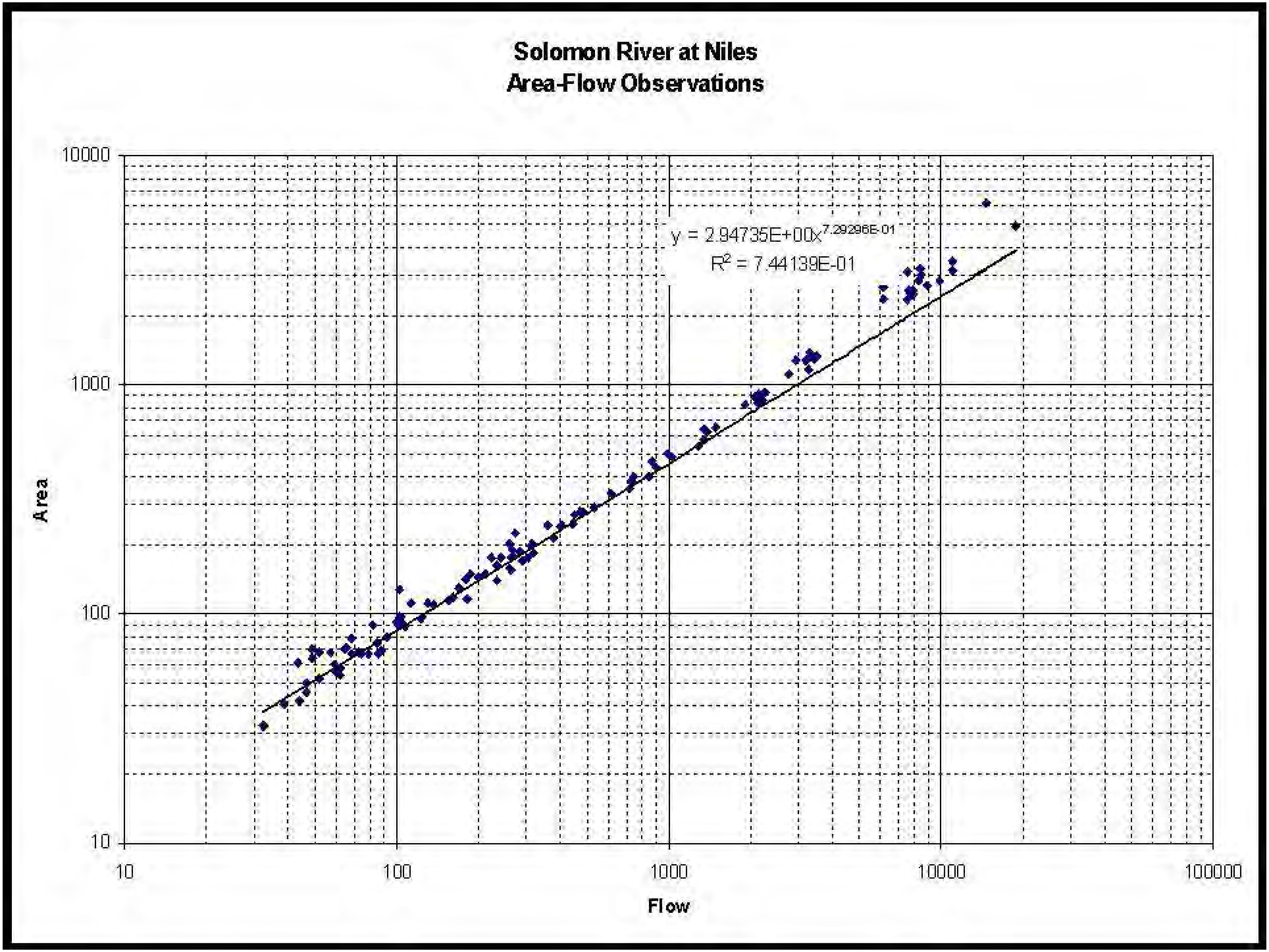
Kansas City District

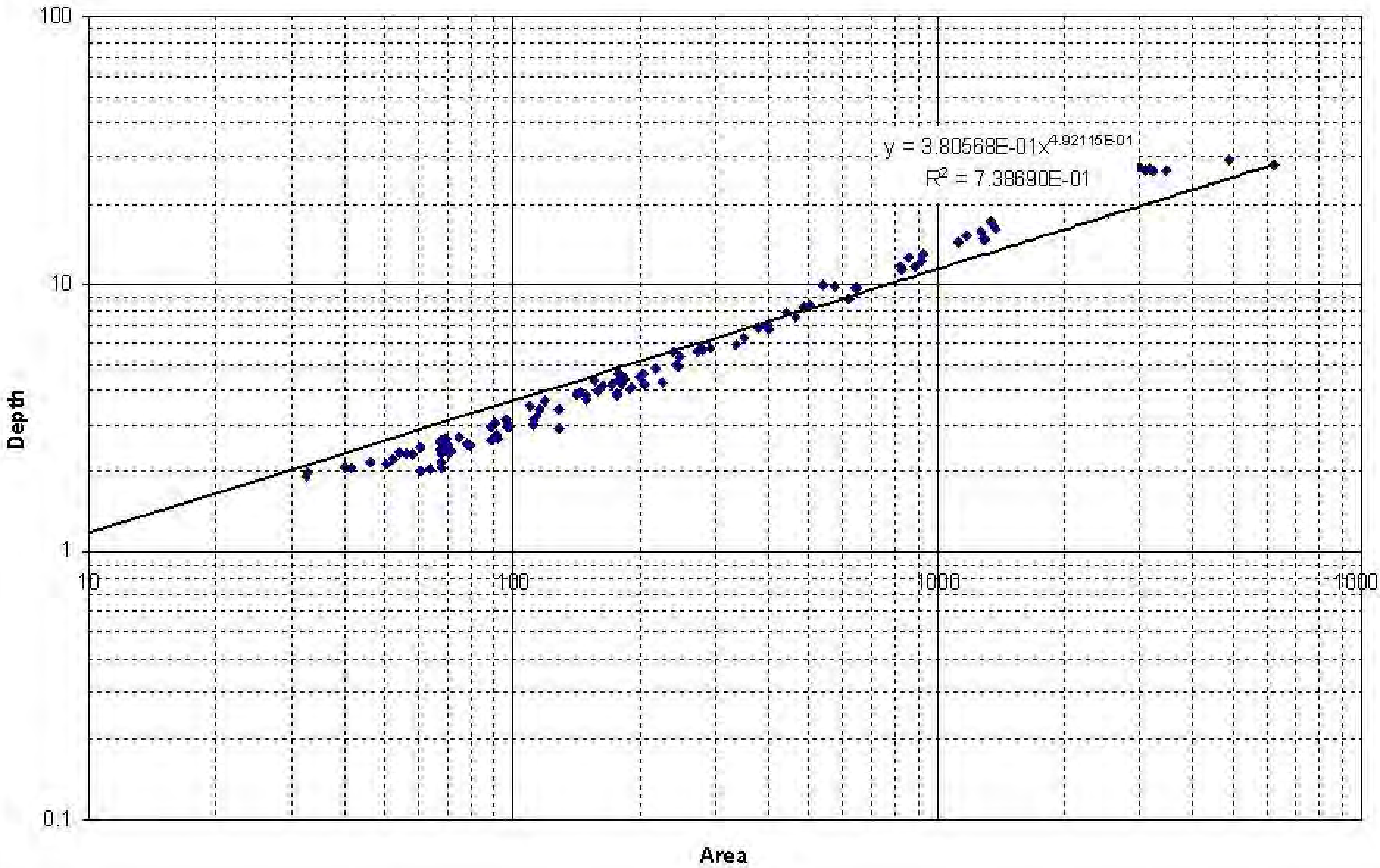
Routing Method

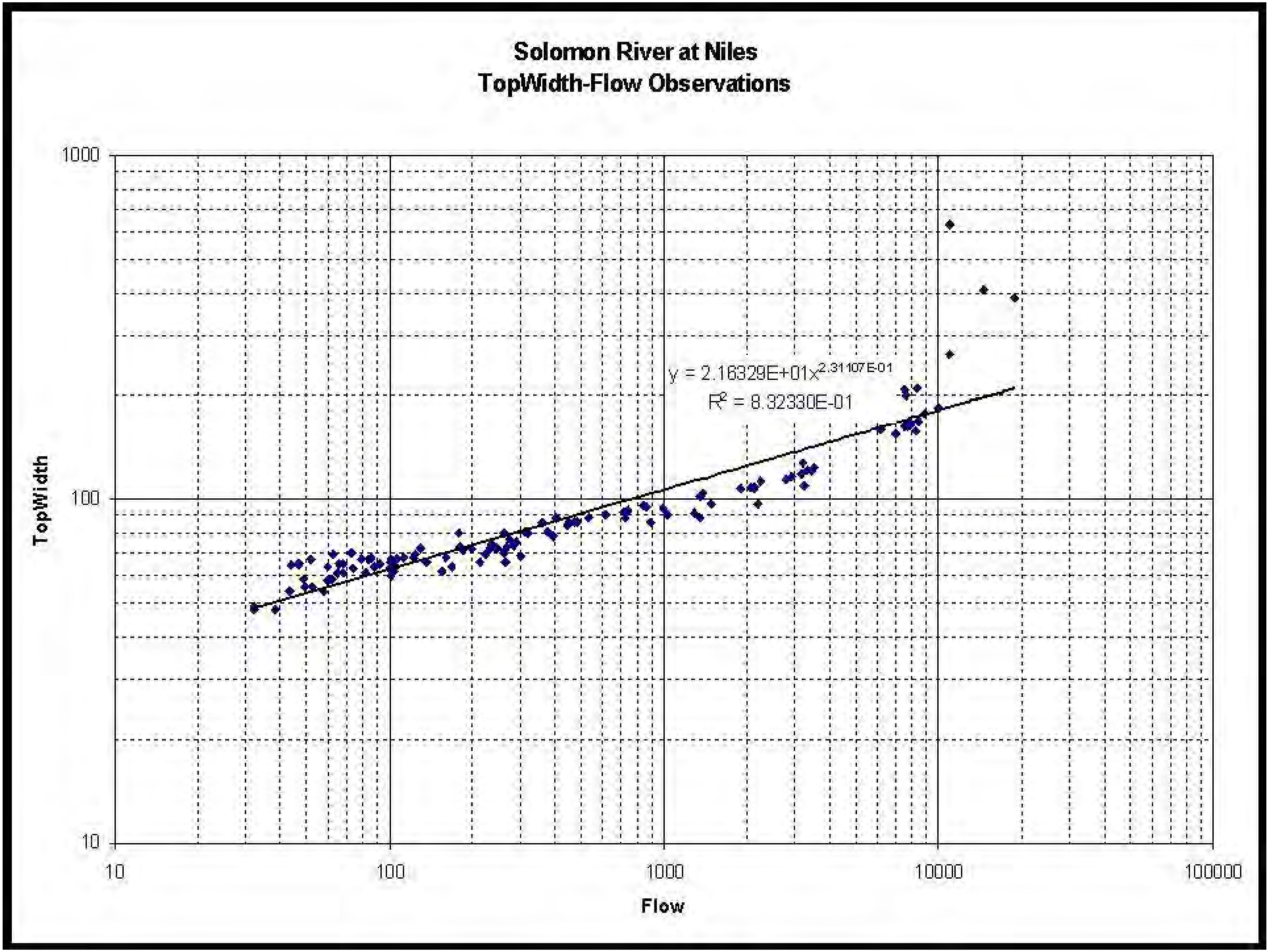
- Muskingum-Cunge
- River Geometry
  - Depth To Flow Power Function
    - Area-Flow
    - Depth-Area
    - TopWidth-Flow



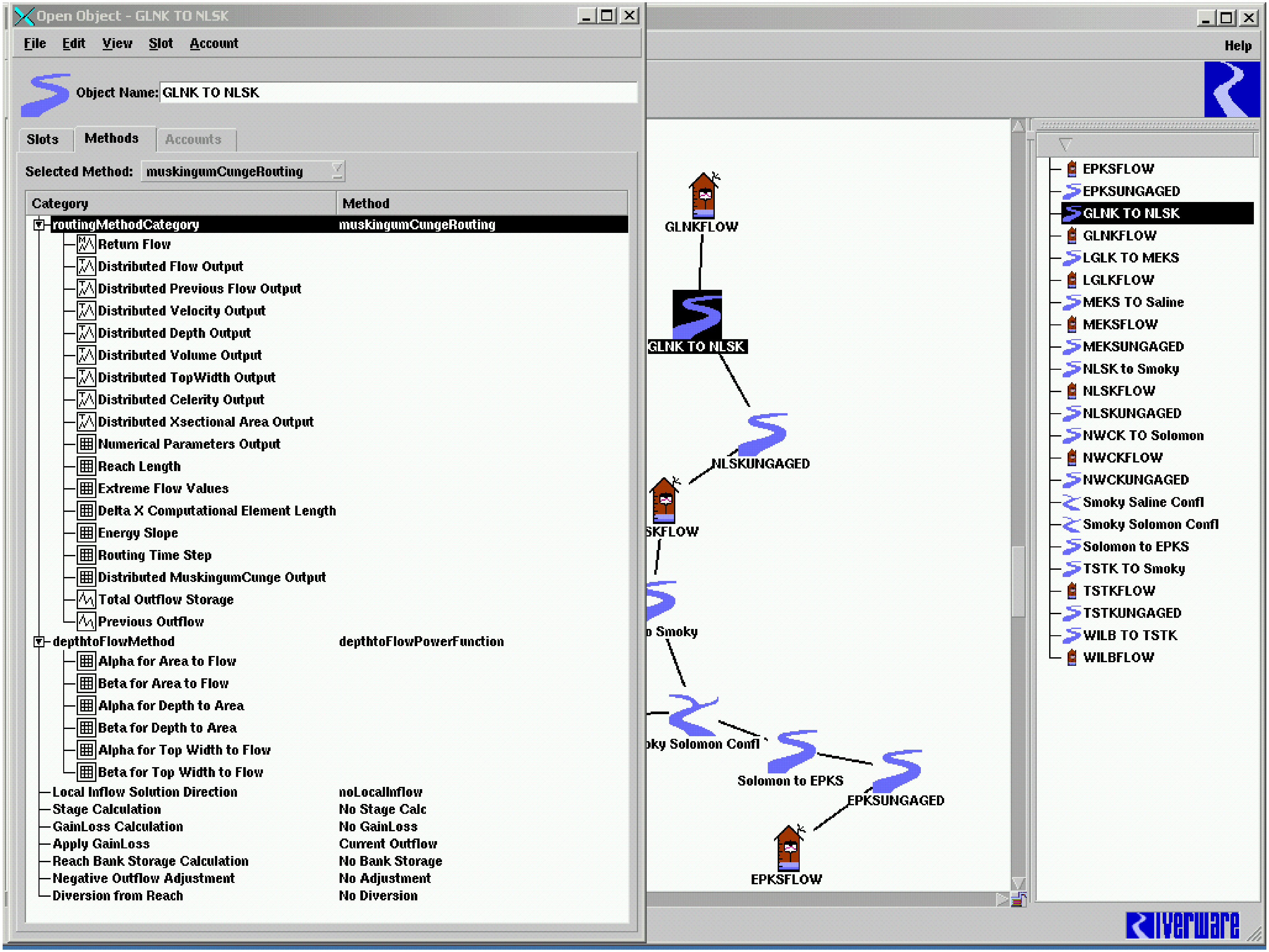
Solomon River at Niles
Area-Flow Observations
y = 2.94735E+00x^7.29296E-01
R^2 = 7.44139E-01
10000
1000
100
10
Area
10
100
1000
10000
100000
Flow

Solomon River at Niles
Depth-Area Observations





Solomon River at Niles
TopWidth-Flow Observations
y = 2.16329E+01x^2.31107E-01
R^2 = 8.32330E-01
TopWidth
Flow
1000
100
10
10
100
1000
10000
100000



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Slots
Methods
Accounts
Selected Method: muskingumCungeRouting
Category
Method
routingMethodCategory
muskingumCungeRouting
Return Flow
Distributed Flow Output
Distributed Previous Flow Output
Distributed Velocity Output
Distributed Depth Output
Distributed Volume Output
Distributed TopWidth Output
Distributed Celerity Output
Distributed Xsectional Area Output
Numerical Parameters Output
Reach Length
Extreme Flow Values
Delta X Computational Element Length
Energy Slope
Routing Time Step
Distributed MuskingumCunge Output
Total Outflow Storage
Previous Outflow
depthtoFlowMethod
depthtoFlowPowerFunction
Alpha for Area to Flow
Beta for Area to Flow
Alpha for Depth to Area
Beta for Depth to Area
Alpha for Top Width to Flow
Beta for Top Width to Flow
Local Inflow Solution Direction
noLocalInflow
Stage Calculation
No Stage Calc
GainLoss Calculation
No GainLoss
Apply GainLoss
Current Outflow
Reach Bank Storage Calculation
No Bank Storage
Negative Outflow Adjustment
No Adjustment
Diversion from Reach
No Diversion
Help
GLNKFLOW
GLNK TO NLSK
NLSKUNGAGED
SKFLOW
o Smoky
oky Solomon Confl
Solomon to EPKS
EPKSUNGAGED
EPKSFLOW
EPKSFLOW
EPKSUNGAGED
GLNK TO NLSK
GLNKFLOW
LGLK TO MEKS
LGLKFLOW
MEKS TO Saline
MEKSFLOW
MEKSUNGAGED
NLSK to Smoky
NLSKFLOW
NLSKUNGAGED
NWCK TO Solomon
NWCKFLOW
NWCKUNGAGED
Smoky Saline Confl
Smoky Solomon Confl
Solomon to EPKS
TSTK TO Smoky
TSTKFLOW
TSTKUNGAGED
WILB TO TSTK
WILBFLOW

Modeling Process

- Create uncontrolled Model of historic flows
  - Historic flow at dam sites or lake releases
  - Historic river gage flow
  - Route flow to next downstream gage
  - Compare routed flow with the historic gage flow

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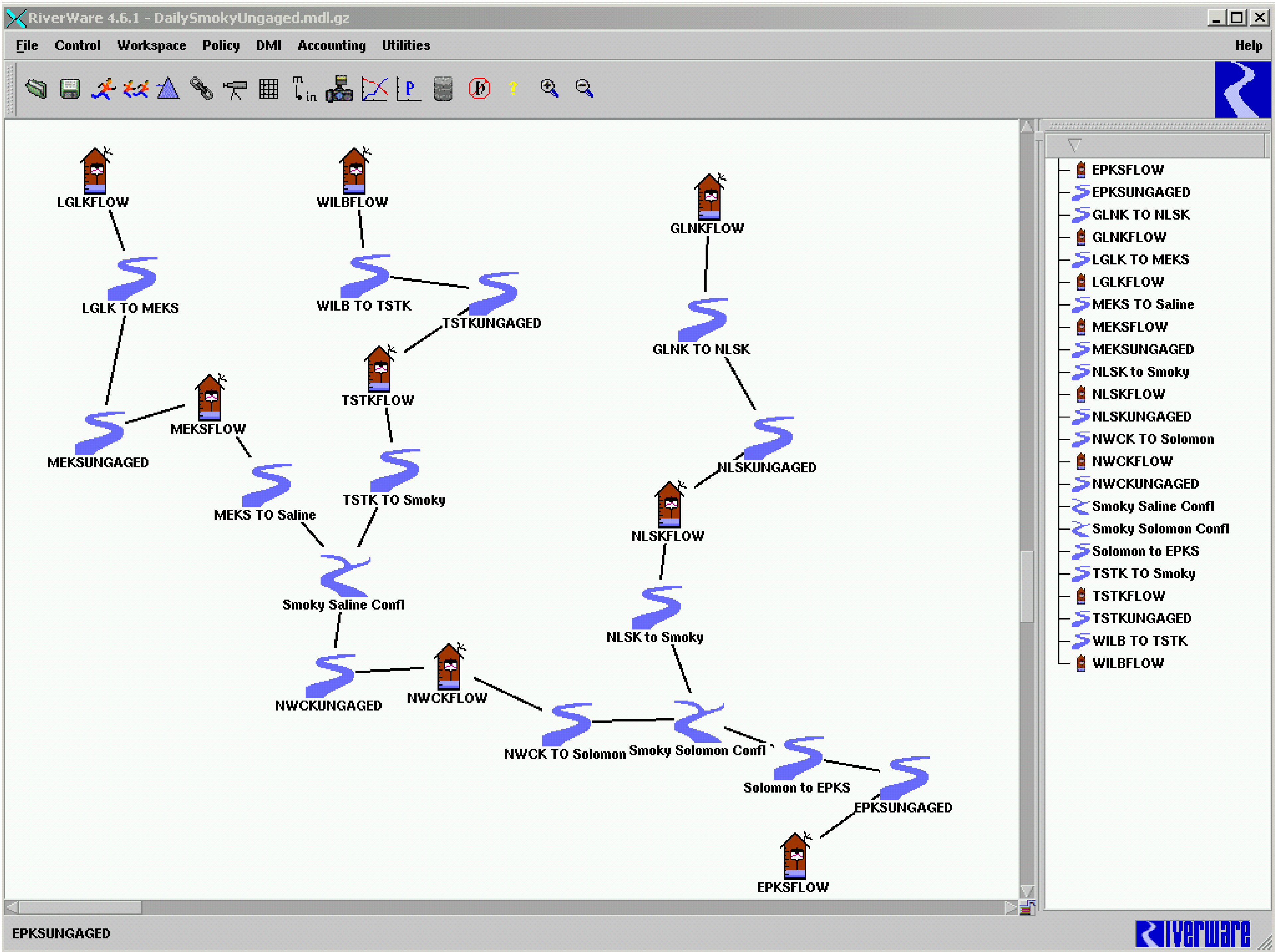
of Engineers
Kansas City District



RiverWare 4.6.1 - DailySmokyUngaged.mdl.gz
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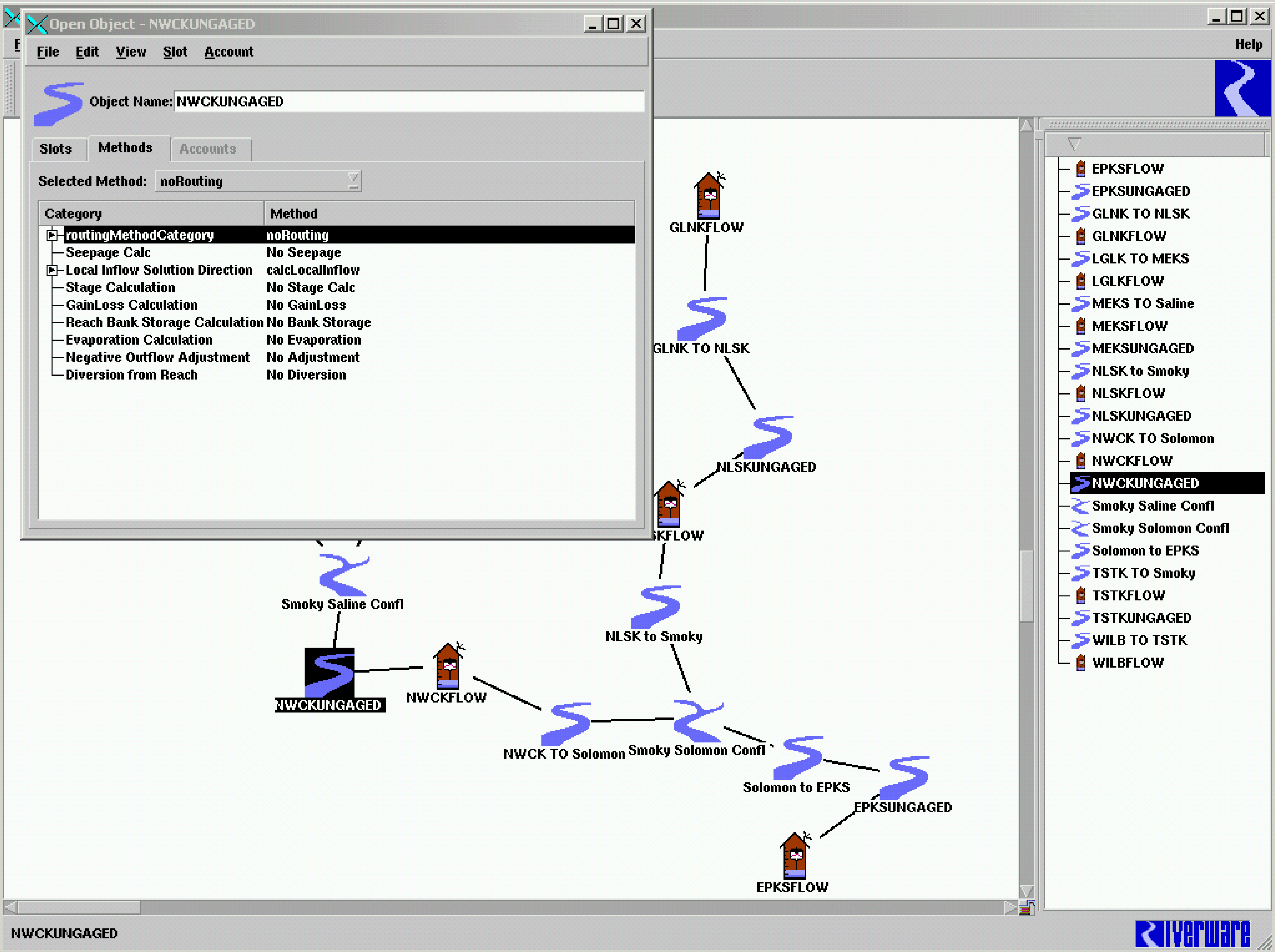
WILBFLOW
GLNKFLOW
LGLK TO MEKS
WILB TO TSTK
TSTKUNGAGED
GLNK TO NLSK
TSTKFLOW
MEKSFLOW
MEKSUNGAGED
NLSKUNGAGED
MEKS TO Saline
TSTK TO Smoky
NLSKFLOW
Smoky Saline Confl
NLSK to Smoky
NWCKUNGAGED
NWCKFLOW
NWCK TO Solomon
Smoky Solomon Confl
Solomon to EPKS
EPKSUNGAGED
EPKSFLOW
EPKSFLOW
EPKSUNGAGED
GLNK TO NLSK
GLNKFLOW
LGLK TO MEKS
LGLKFLOW
MEKS TO Saline
MEKSFLOW
MEKSUNGAGED
NLSK to Smoky
NLSKFLOW
NLSKUNGAGED
NWCK TO Solomon
NWCKFLOW
NWCKUNGAGED
Smoky Saline Confl
Smoky Solomon Confl
Solomon to EPKS
TSTK TO Smoky
TSTKFLOW
TSTKUNGAGED
WILB TO TSTK
WILBFLOW
EPKSUNGAGED
RiverWare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File
Edit
View
Slot
Account
Help
Object Name: NWCKUNGAGED
Slots
Methods
Accounts
Selected Method: noRouting
Category
Method
routingMethodCategory
noRouting
Seepage Calc
No Seepage
Local Inflow Solution Direction
calcLocalInflow
Stage Calculation
No Stage Calc
GainLoss Calculation
No GainLoss
Reach Bank Storage Calculation
No Bank Storage
Evaporation Calculation
No Evaporation
Negative Outflow Adjustment
No Adjustment
Diversion from Reach
No Diversion
GLNKFLOW
GLNK TO NLSK
NLSKUNGAGED
Smoky Saline Confl
NLSK to Smoky
NWCKUNGAGED
NWCKFLOW
NWCK TO Solomon
Smoky Solomon Confl
Solomon to EPKS
EPKSUNGAGED
EPKSFLOW
EPKSFLOW
EPKSUNGAGED
GLNK TO NLSK
GLNKFLOW
LGLK TO MEKS
LGLKFLOW
MEKS TO Saline
MEKSFLOW
MEKSUNGAGED
NLSK to Smoky
NLSKFLOW
NLSKUNGAGED
NWCK TO Solomon
NWCKFLOW
NWCKUNGAGED
Smoky Saline Confl
Smoky Solomon Confl
Solomon to EPKS
TSTK TO Smoky
TSTKFLOW
TSTKUNGAGED
WILB TO TSTK
WILBFLOW
NWCKUNGAGED

Negative Ungaged Flow

- Causes
  - Changed stream conditions affect routing
  - Input data challenges
  - Stream depletions
- Solution
  - Separate positive and negative values
  - Average negative values over 31 day period
  - Apply values over the period
  - Remaining negative values treated as losses

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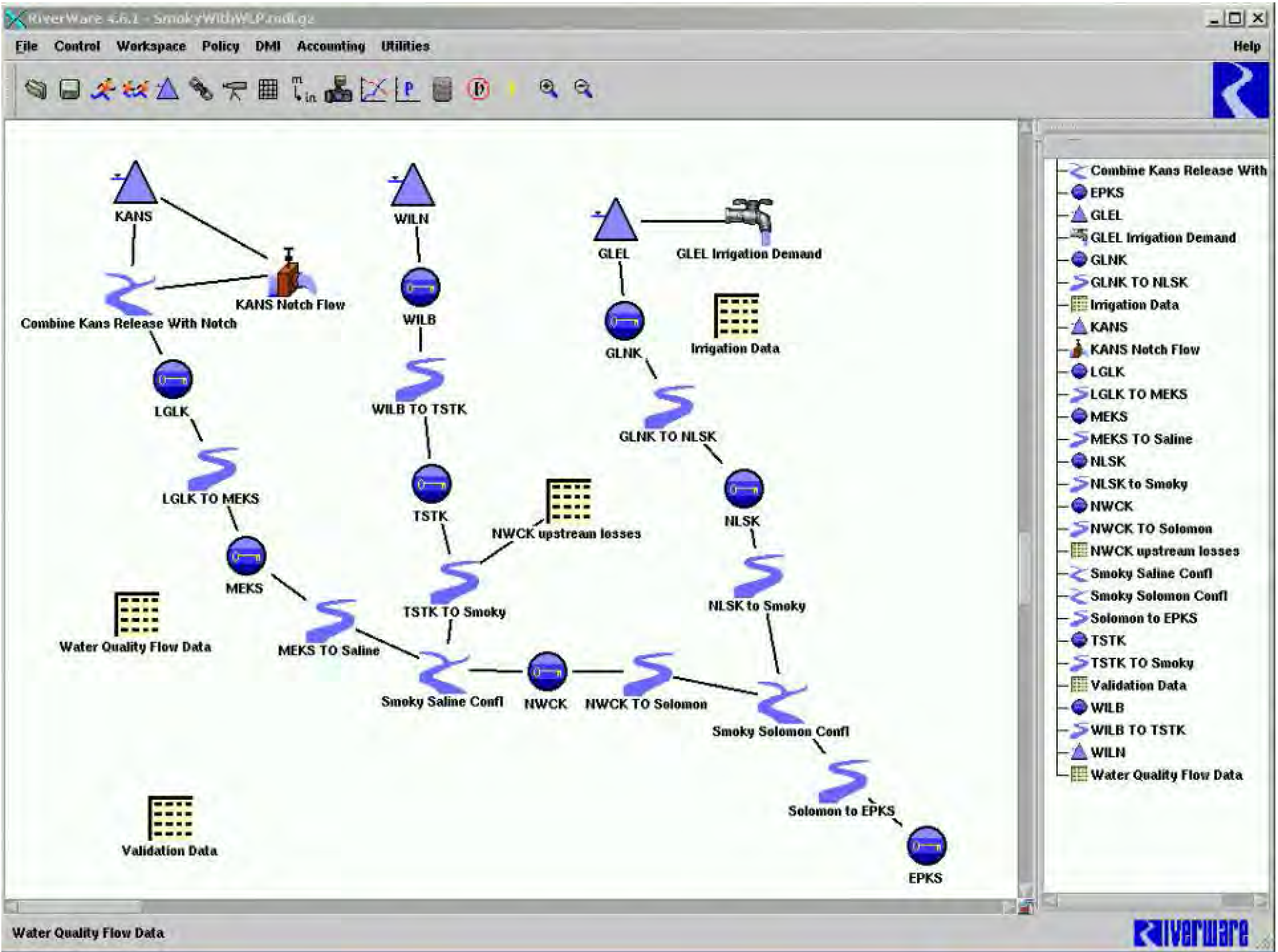
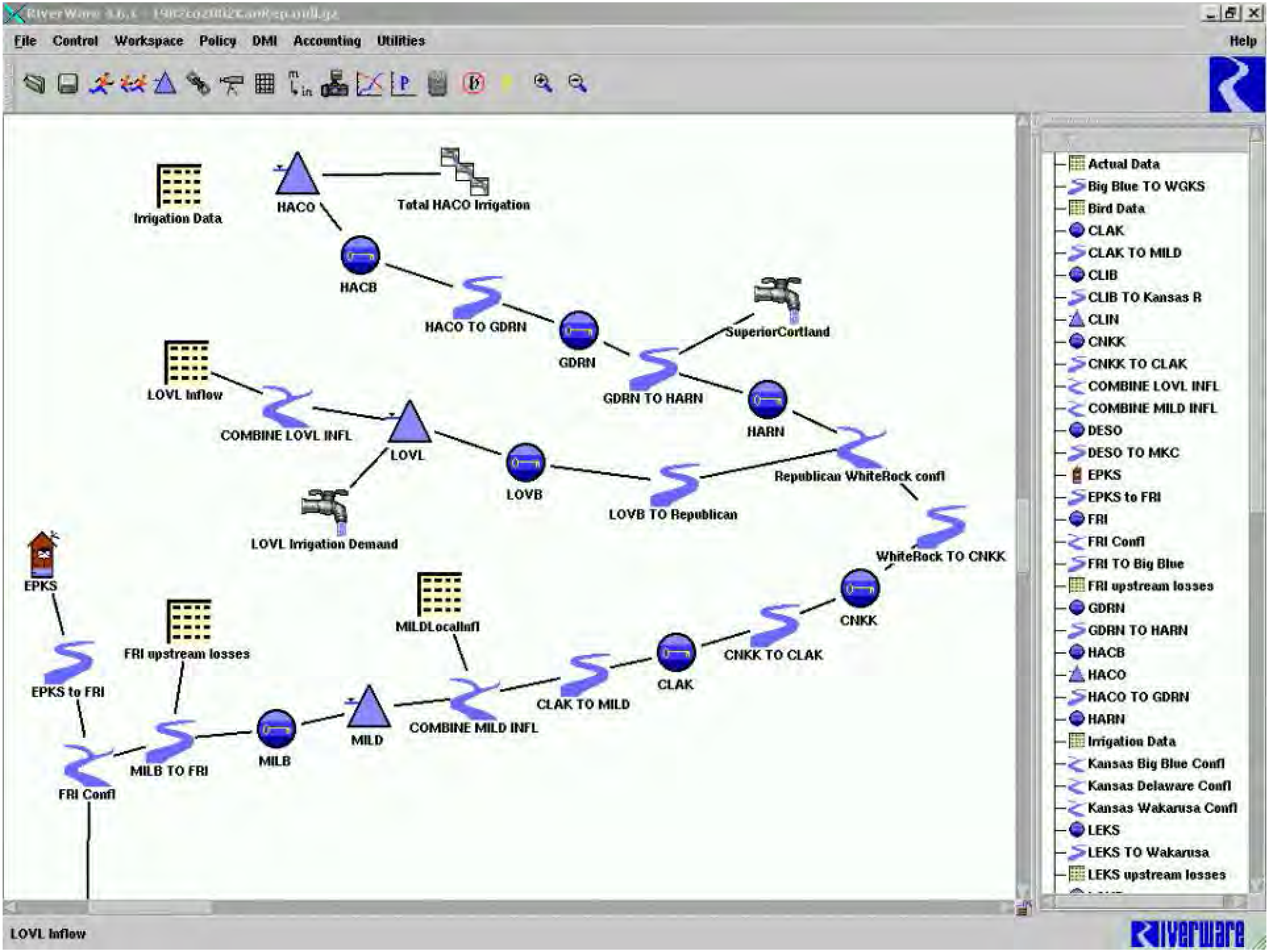
Kansas City District



File
Control
Workspace
Policy
DMI
Accounting
Utilities
Help
KANS
WILN
GLEL
GLEL Irrigation Demand
KANS Notch Flow
Combine Kans Release With Notch
WILB
GLNK
Irrigation Data
LGLK
WILB TO TSTK
GLNK TO NLSK
LGLK TO MEKS
TSTK
NWCK upstream losses
NLSK
MEKS
TSTK TO Smoky
NLSK to Smoky
Water Quality Flow Data
MEKS TO Saline
Smoky Saline Confl
NWCK
NWCK TO Solomon
Smoky Solomon Confl
Solomon to EPKS
Validation Data
EPKS
Combine Kans Release With
EPKS
GLEL
GLEL Irrigation Demand
GLNK
GLNK TO NLSK
Irrigation Data
KANS
KANS Notch Flow
LGLK
LGLK TO MEKS
MEKS
MEKS TO Saline
NLSK
NLSK to Smoky
NWCK
NWCK TO Solomon
NWCK upstream losses
Smoky Saline Confl
Smoky Solomon Confl
Solomon to EPKS
TSTK
TSTK TO Smoky
Validation Data
WILB
WILB TO TSTK
WILN
Water Quality Flow Data
Water Quality Flow Data



File
Control
Workspace
Policy
DMI
Accounting
Utilities
Help
Irrigation Data
HACO
Total HACO Irrigation
HACB
HACO TO GDRN
GDRN
SuperiorCortland
GDRN TO HARN
HARN
LOVL Inflow
COMBINE LOVL INFL
LOVL
LOVB
LOVB TO Republican
Republican WhiteRock confl
LOVL Irrigation Demand
WhiteRock TO CNKK
EPKS
CNKK
MILDLocalInfl
FRI upstream losses
CNKK TO CLAK
CLAK
CLAK TO MILD
EPKS to FRI
COMBINE MILD INFL
MILD
MILB
MILB TO FRI
FRI Confl
Actual Data
Big Blue TO WGKS
Bird Data
CLAK
CLAK TO MILD
CLIB
CLIB TO Kansas R
CLIN
CNKK
CNKK TO CLAK
COMBINE LOVL INFL
COMBINE MILD INFL
DESO
DESO TO MKC
EPKS
EPKS to FRI
FRI
FRI Confl
FRI TO Big Blue
FRI upstream losses
GDRN
GDRN TO HARN
HACB
HACO
HACO TO GDRN
HARN
Irrigation Data
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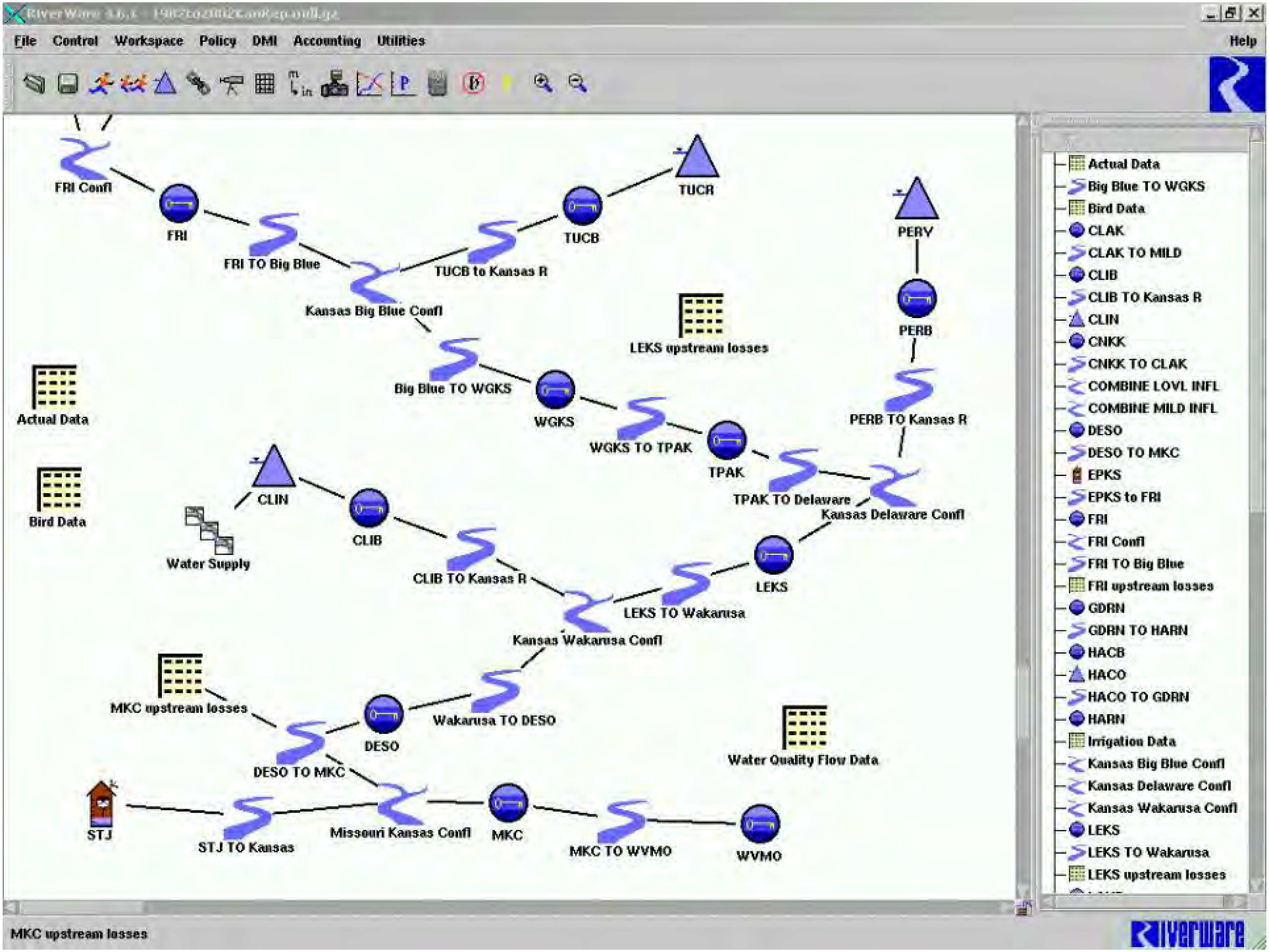
Kansas Delaware Confl
Kansas Wakarusa Confl
LEKS
LEKS TO Wakarusa
LEKS upstream losses
LOVL Inflow



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TUCB to Kansas R
TUCB
TUCR
PERV
Kansas Big Blue Confl
LEKS upstream losses
PERB
Actual Data
Big Blue TO WGKS
WGKS
WGKS TO TPAK
TPAK
PERB TO Kansas R
Bird Data
CLIN
CLIB
Water Supply
TPAK TO Delaware
Kansas Delaware Confl
CLIB TO Kansas R
LEKS
LEKS TO Wakarusa
Kansas Wakarusa Confl
MKC upstream losses
DESO
Wakarusa TO DESO
DESO TO MKC
Water Quality Flow Data
STJ
STJ TO Kansas
Missouri Kansas Confl
MKC
MKC TO WVMO
WVMO
Actual Data
Big Blue TO WGKS
Bird Data
CLAK
CLAK TO MILD
CLIB
CLIB TO Kansas R
CLIN
CNKK
CNKK TO CLAK
COMBINE LOVL INFL
COMBINE MILD INFL
DESO
DESO TO MKC
EPKS
EPKS to FRI
FRI
FRI Confl
FRI TO Big Blue
FRI upstream losses
GDRN
GDRN TO HARN
HACB
HACO
HACO TO GDRN
HARN
Irrigation Data
Kansas Big Blue Confl
Kansas Delaware Confl
Kansas Wakarusa Confl
LEKS
LEKS TO Wakarusa
LEKS upstream losses
MKC upstream losses

Lake Objects

LAKE NAME	RIVER	OBJECT ID
Kanopolis Lake	Smoky Hill River	KANS
Wilson Lake	Saline River	WILN
Waconda Lake (Sec 7)	Solomon River	GLEL
Harlan County Lake	Republican River	HACO
Lovewell Reservoir (Sec 7)	White Rock Creek	LOVL
Milford Lake	Republican River	MILD
Tuttle Creek Lake	Big Blue River	TUCR
Perry Lake	Delaware River	PERY
Clinton Lake	Wakarusa River	CLIN

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Kansas City District

Control Points

Smoky Basin

GAGE NAME	USGS No.	OBJECT ID	LAKES REGULATED
Smoky Hill River:			
Near Langley (KS)	06865500	LNGK	KANS
Near Mentor (KS)	06866500	MEKS	KANS
New Cambria (KS)	06870200	NWCK	KANS, WILN
Enterprise (KS)	06877600	EPKS	KANS, WILN, GLEL
Saline River:			
At Wilson Dam (KS)	06868200	WILB	WILN
Tescott (KS)	06869500	TSTK	WILN
Solomon River:			
Near Glen Elder (KS)	06875900	WACB	GLEL
Niles (KS)	06876900	NLSK	GLEL

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Kansas City District

Kansas/Republican Basin

GAGE NAME	USGS No.	OBJECT ID	LAKES REGULATED
Republican River:			
Below Harlan County Dam (NE)	06849500	HACB	HACO
Guide Rock (NE)	06853020	GDRN	HACO
Hardy (NE)	06853500	HARN	HACO
Concordia (KS)	06856000	CNKK	HACO, LOVL
Clay Center (KS)	06856600	CLCK	HACO, LOVL
Below Milford Dam (KS)	06857100	MILB	MILD
White Rock Creek:			
At Lovewell (KS)	06854000	LOVB	LOVL
Kansas River:			
Fort Riley (KS)	06879100	FRI	MILD
Wamego (KS)	06887500	WGKS	MILD, TUCR
Topeka (KS)	06889000	TPAK	MILD, TUCR
LeCompton (KS)	06891000	LCKS	MILD, TUCR, PERY
DeSoto	06892350	DESO	MILD, TUCR, PERY, CLIN
Big Blue River:			
Manhattan (KS)	06887000	MHKS	TUCR
Delaware River:			
Below Perry Dam (KS)	06890900	PERB	PERY
Wakarusa River:			
Lawrence (KS)	06891500	LWKS	CLIN
Missouri River:			
St. Joseph (MO)	06818000	STJ	<NONE>
Kansas City (MO)	06893000	MKC	MILD, TUCR, PERY, CLIN
Waverly (MO)	06895500	WVMO	MILD, TUCR, PERY, CLIN

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Kansas City District

Reaches

Reach objects: The river length between each adjacent control point, or the river length between a control point and a major confluence.

Major Confluences:

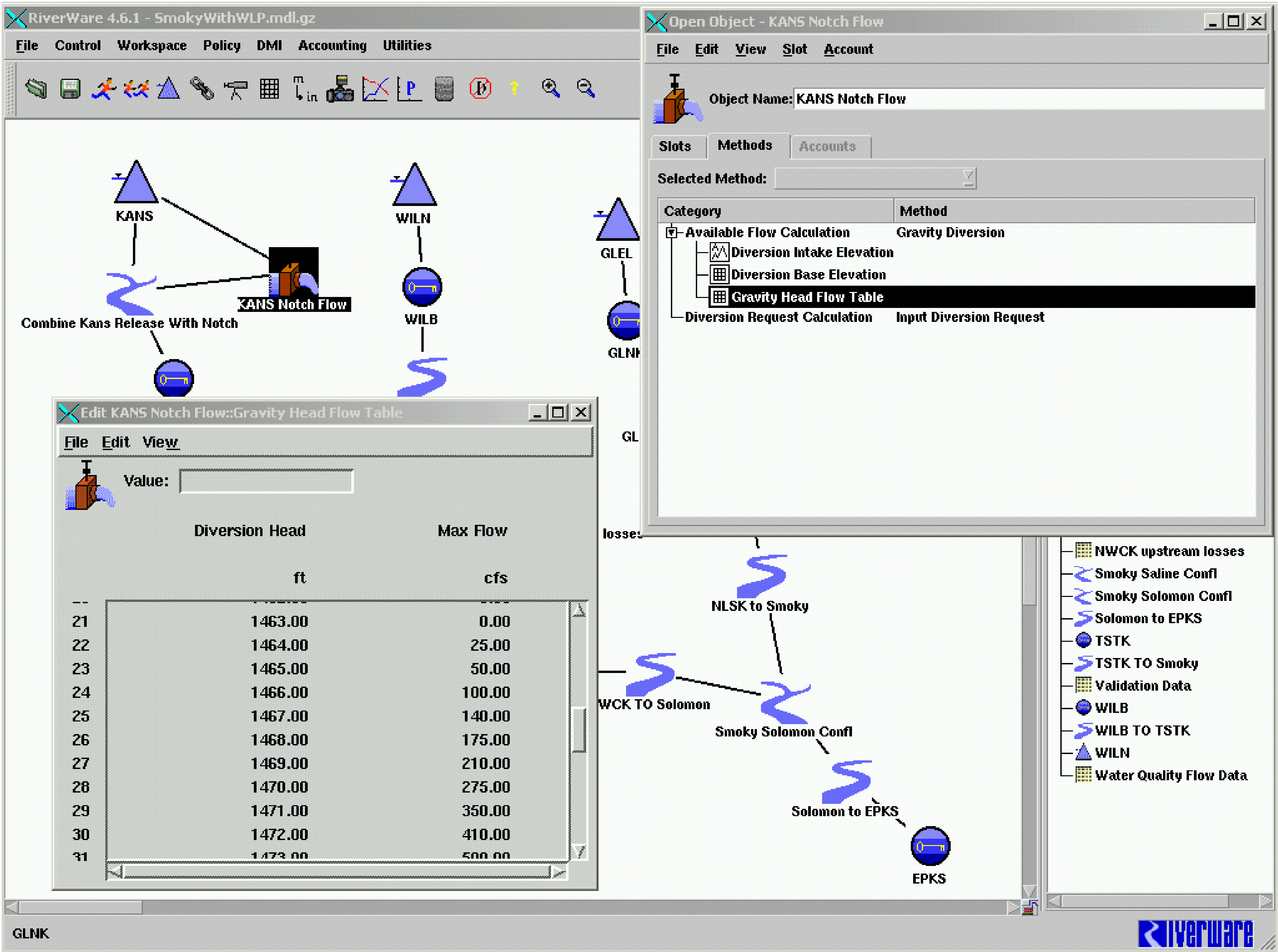
– Smoky-Saline
– Smoky-Solomon
– Republican-White Rock
– Smoky-Republican
– Kansas-Big Blue
– Kansas-Delaware
– Kansas-Wakarusa
– Kansas-Missouri

US Army Corps of Engineers
Kansas City District

Model Data Inputs

- Lake Physical Characteristics
  - Area-Capacity, Surcharge Curves, Outlet Capacity
- Lake Operation Criteria
  - Surcharge, Phase Levels and Flows, Tandem Balance
- Daily Lake Inflow
- Lake Evaporation, Precipitation
- Lake Demands
  - Water Supply/Quality, Irrigation, Navigation
- Reach Loss
- Control Point Ungaged Local Inflow
- Reach Geometry
  - Taken from USGS measurements

US Army Corps of Engineers
Kansas City District



RiverWare 4.6.1 - SmokyWithWLP.mdl.gz
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WILN
GLEL
KANS Notch Flow
Combine Kans Release With Notch
WILB
GLNK
Edit KANS Notch Flow::Gravity Head Flow Table
File Edit View
Value:
Diversion Head
Max Flow
ft
cfs
21 1463.00 0.00
22 1464.00 25.00
23 1465.00 50.00
24 1466.00 100.00
25 1467.00 140.00
26 1468.00 175.00
27 1469.00 210.00
28 1470.00 275.00
29 1471.00 350.00
30 1472.00 410.00
Open Object - KANS Notch Flow
File Edit View Slot Account
Object Name: KANS Notch Flow
Slots Methods Accounts
Selected Method:
Category Method
Available Flow Calculation Gravity Diversion
Diversion Intake Elevation
Diversion Base Elevation
Gravity Head Flow Table
Diversion Request Calculation Input Diversion Request
NLSK to Smoky
WCK TO Solomon
Smoky Solomon Confl
Solomon to EPKS
EPKS
NWCK upstream losses
Smoky Saline Confl
Smoky Solomon Confl
Solomon to EPKS
TSTK
TSTK TO Smoky
Validation Data
WILB
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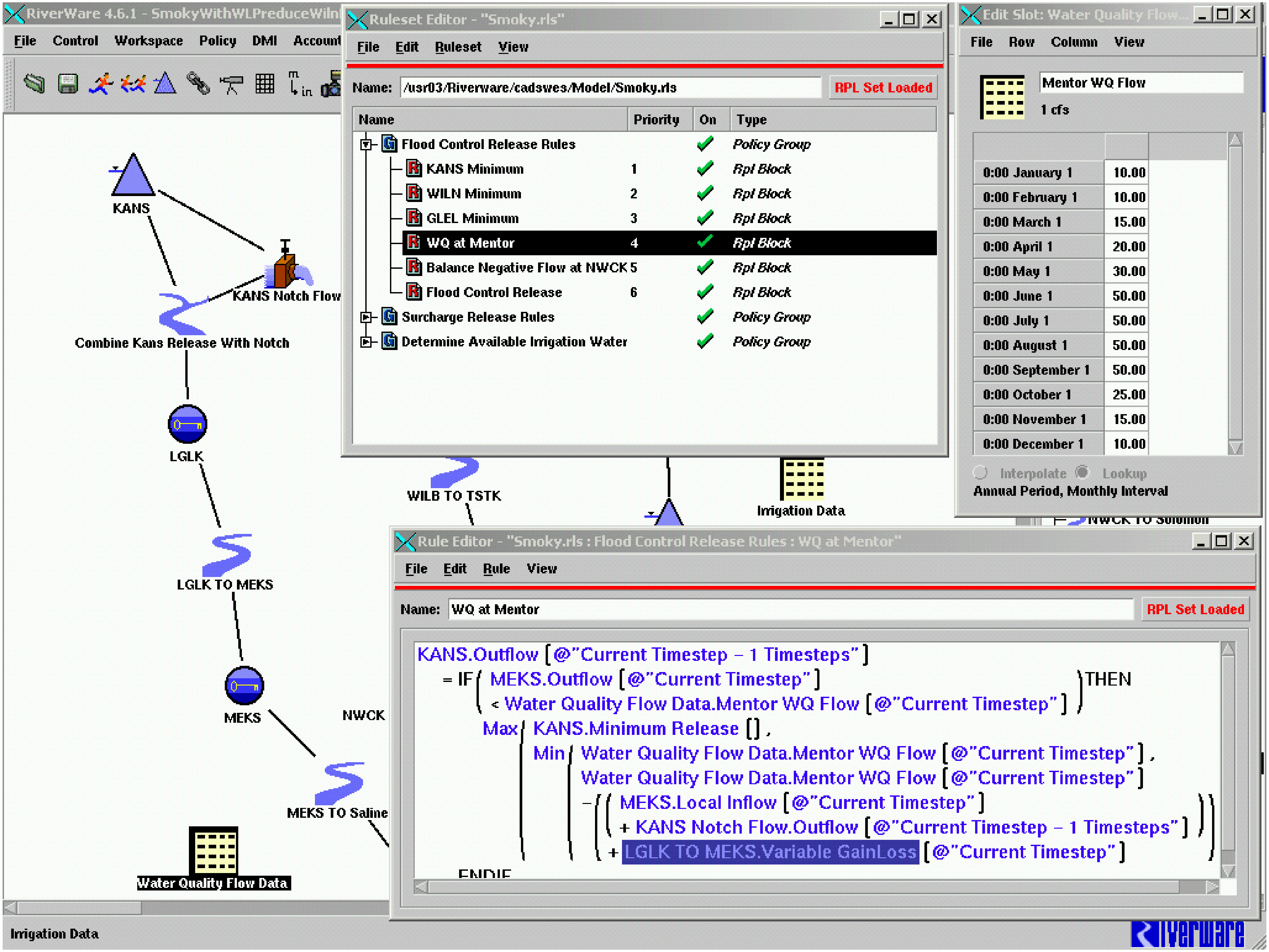
WILN
Water Quality Flow Data
GLNK



RiverWare 4.6.1 - SmokyWithWLPreduceWilni
File Control Workspace Policy DMI Account
KANS
KANS Notch Flow
Combine Kans Release With Notch
LGLK
LGLK TO MEKS
MEKS
NWCK
MEKS TO Saline
Water Quality Flow Data
WILB TO TSTK
Irrigation Data
Ruleset Editor - "Smoky.rls"
File Edit Ruleset View
Name: /usr03/Riverware/cadswes/Model/Smoky.rls
RPL Set Loaded
Name Priority On Type
Flood Control Release Rules Policy Group
KANS Minimum 1 Rpl Block
WILN Minimum 2 Rpl Block
GLEL Minimum 3 Rpl Block
WQ at Mentor 4 Rpl Block
Balance Negative Flow at NWCK 5 Rpl Block
Flood Control Release 6 Rpl Block
Surcharge Release Rules Policy Group
Determine Available Irrigation Water Policy Group
Edit Slot: Water Quality Flow...
File Row Column View
Mentor WQ Flow
1 cfs
0:00 January 1 10.00
0:00 February 1 10.00
0:00 March 1 15.00
0:00 April 1 20.00
0:00 May 1 30.00
0:00 June 1 50.00
0:00 July 1 50.00
0:00 August 1 50.00
0:00 September 1 50.00
0:00 October 1 25.00
0:00 November 1 15.00
0:00 December 1 10.00
Interpolate Lookup
Annual Period, Monthly Interval
Rule Editor - "Smoky.rls : Flood Control Release Rules : WQ at Mentor"
File Edit Rule View
Name: WQ at Mentor
RPL Set Loaded
KANS.Outflow [@"Current Timestep – 1 Timesteps"]
= IF (MEKS.Outflow [@"Current Timestep"]
< Water Quality Flow Data.Mentor WQ Flow [@"Current Timestep"]) THEN
Max (KANS.Minimum Release [],
Min (Water Quality Flow Data.Mentor WQ Flow [@"Current Timestep"],
Water Quality Flow Data.Mentor WQ Flow [@"Current Timestep"]
– ((MEKS.Local Inflow [@"Current Timestep"]
+ KANS Notch Flow.Outflow [@"Current Timestep – 1 Timesteps"])
+ LGLK TO MEKS.Variable GainLoss [@"Current Timestep"])))
ENDIF
Irrigation Data

RiverWare Calibration Slots

Lake Objects

- Objective Release Pattern
- Objective Release Pattern Threshold
- Phase Tolerance
- Permissible Outflow Increase Constraints
- Permissible Outflow Decrease Constraints

Control Points

- Phase Space Tolerance

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Reach Calibration

- Review ungaged calculation
- Extreme values may indicate poor routing
- Negative values at edges of hydrograph
  - Incorrect travel time
  - Insufficient attenuation
  - Positive values may be local inflow

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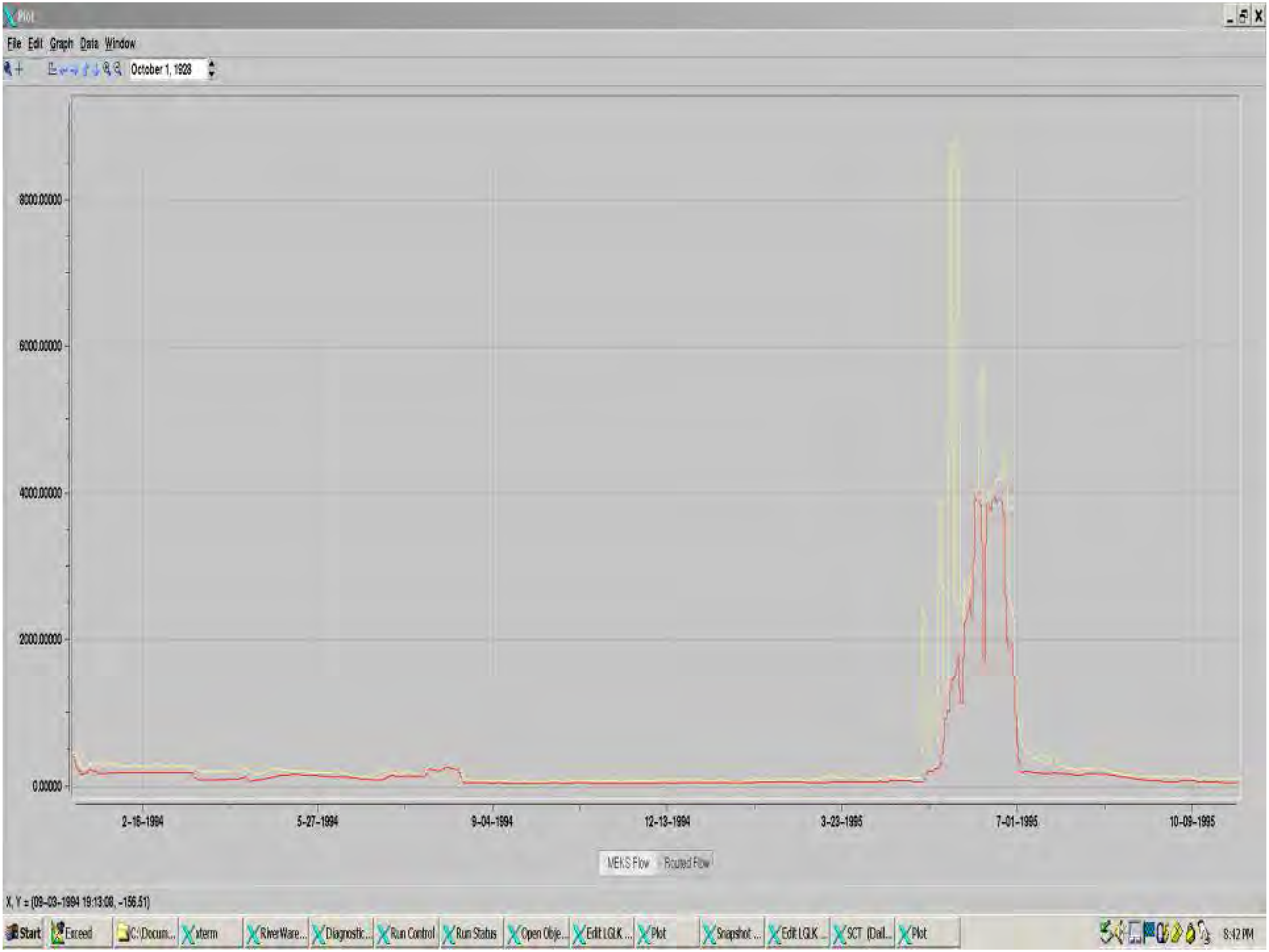
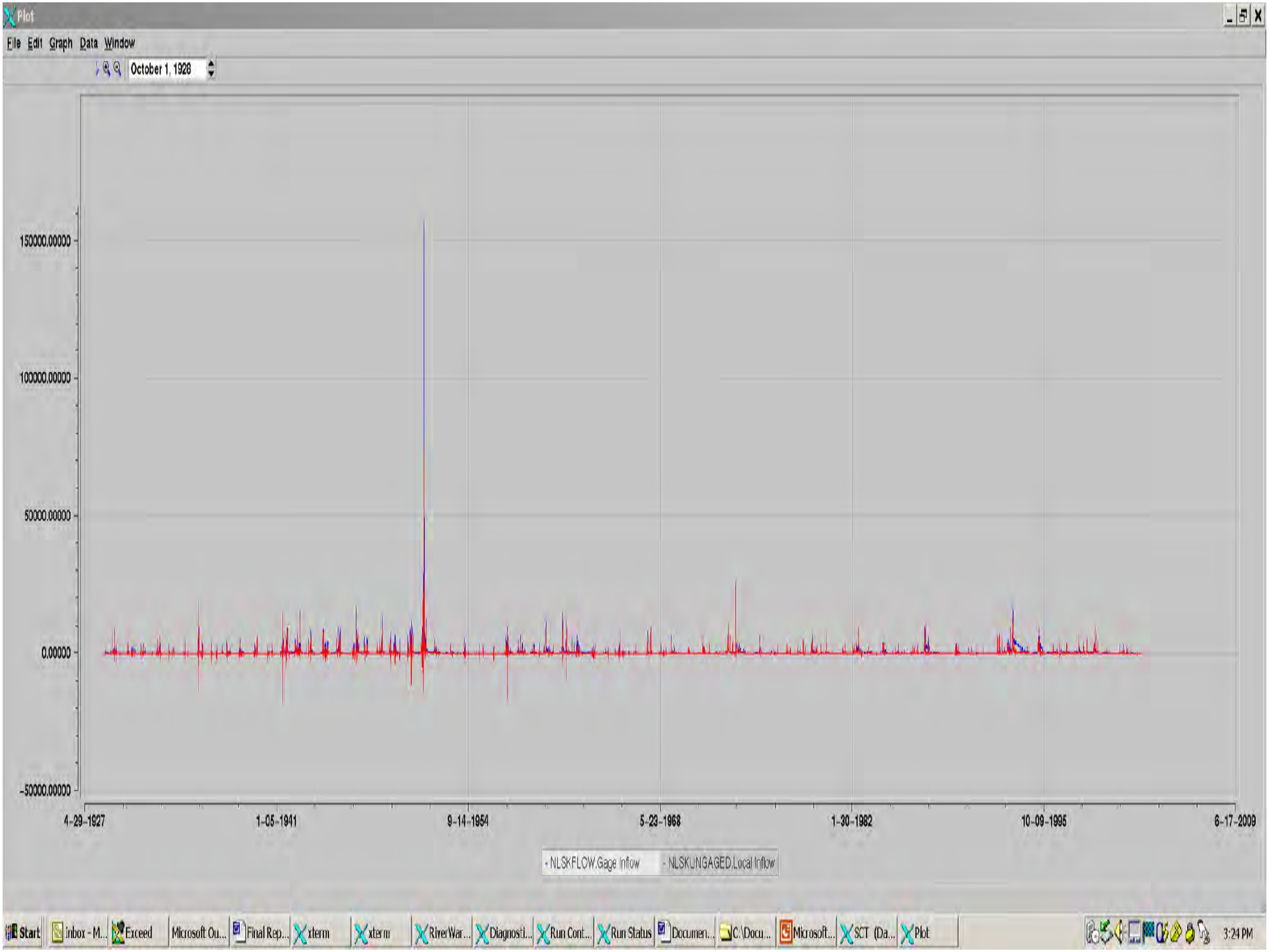

Plot
File Edit Graph Data Window
October 1, 1928
8000.00000
6000.00000
4000.00000
2000.00000
0.00000
2-16-1994
5-27-1994
9-04-1994
12-13-1994
3-23-1995
7-01-1995
10-09-1995
MEKS Flow
Routed Flow
X, Y = (09-03-1994 19:13:08, -156.51)
Start
Exceed
xterm
RiverWare...
Diagnostic...
Run Control
Run Status
Open Obje...
Edit LGLK ...
Plot
Snapshot ...
Edit LGLK ...
SCT (Dail...
Plot
8:42 PM



Plot
File Edit Graph Data Window
October 1, 1928
150000.00000
100000.00000
50000.00000
0.00000
-50000.00000
4-29-1927
1-05-1941
9-14-1954
5-23-1968
1-30-1982
10-09-1995
6-17-2009
NLSKFLOW.Gage Inflow
NLSKUNGAGED.Local Inflow
Start
3:24 PM

RiverWare Enhancements

- Phase Balance Flood Control
- Surcharge Operation
  - Pass Inflows
  - Induced Surcharge Curve
  - Specified Surcharge

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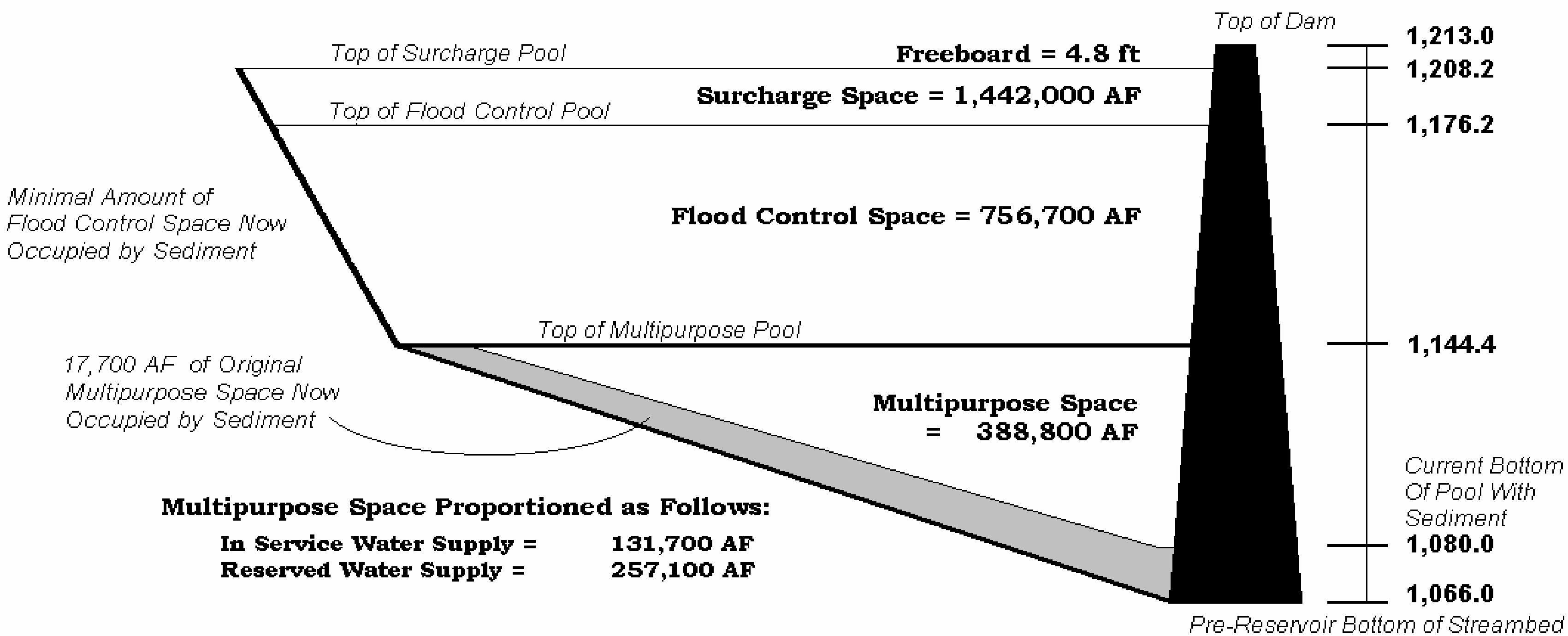
Milford Lake
Current Storage Allocations

As of Last Sediment Survey in 1980



Multipurpose Space Proportioned as Follows:

In Service Water Supply =	131,700 AF
Reserved Water Supply =	257,100 AF

Storage Allocations	At Closure (1964)	Current	At End of Design Life
Flood Control	754,800 AF	756,700 AF	700,000 AF
Multipurpose	406,500 AF		
Water Supply			
In Service		131,700 AF	101,650 AF
Reserved		257,100 AF	198,350 AF

Phase Balance / Surcharge Validation

- Hypothetical Flow Events
  - Input high steady inflow to Lakes
  - Check flow at downstream Control Points
  - Insure that lake operation appropriate
  - Check tandem operation of HACO & LOVL
- Six hour model of each surcharge method
  - Rout spillway design flood
  - Insure appropriate lake elevation/release

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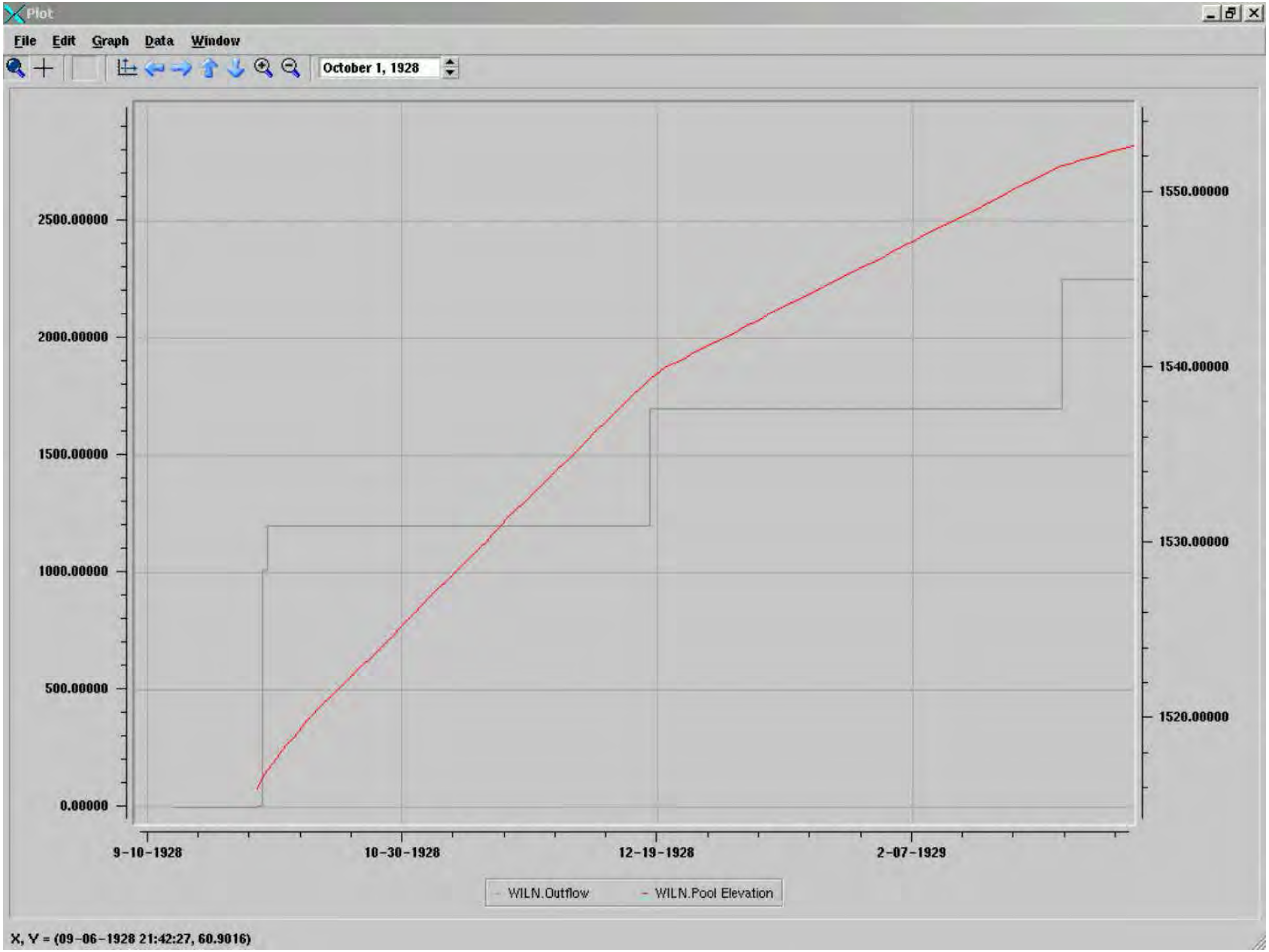
Plot
File Edit Graph Data Window
October 1, 1928
2500.00000
2000.00000
1500.00000
1000.00000
500.00000
0.00000
1550.00000
1540.00000
1530.00000
1520.00000
9-10-1928
10-30-1928
12-19-1928
2-07-1929
WILN.Outflow
WILN.Pool Elevation
X, Y = (09-06-1928 21:42:27, 60.9016)

Surcharge Validation

	Manual Study (2 hour data)		RiverWare (6 hour data)	
	Peak Elev	Max Release	Peak Elev	Max Release
Clinton	921.7	54,500 cfs	921.39	55,040 cfs
Tuttle	1151.4	579,000 cfs	1151.79	587,360 cfs
Milford	1207.13	549,000 cfs	1207.4	551,000 cfs

Model Validation

- Validation Period: 1982 through 2001
- Lakes Constructed Prior to 1982
- Input Data Higher Quality
- Very Dry Period
  - 1988 through 1992
- Very Wet Period
  - 1993
- Ongoing Process

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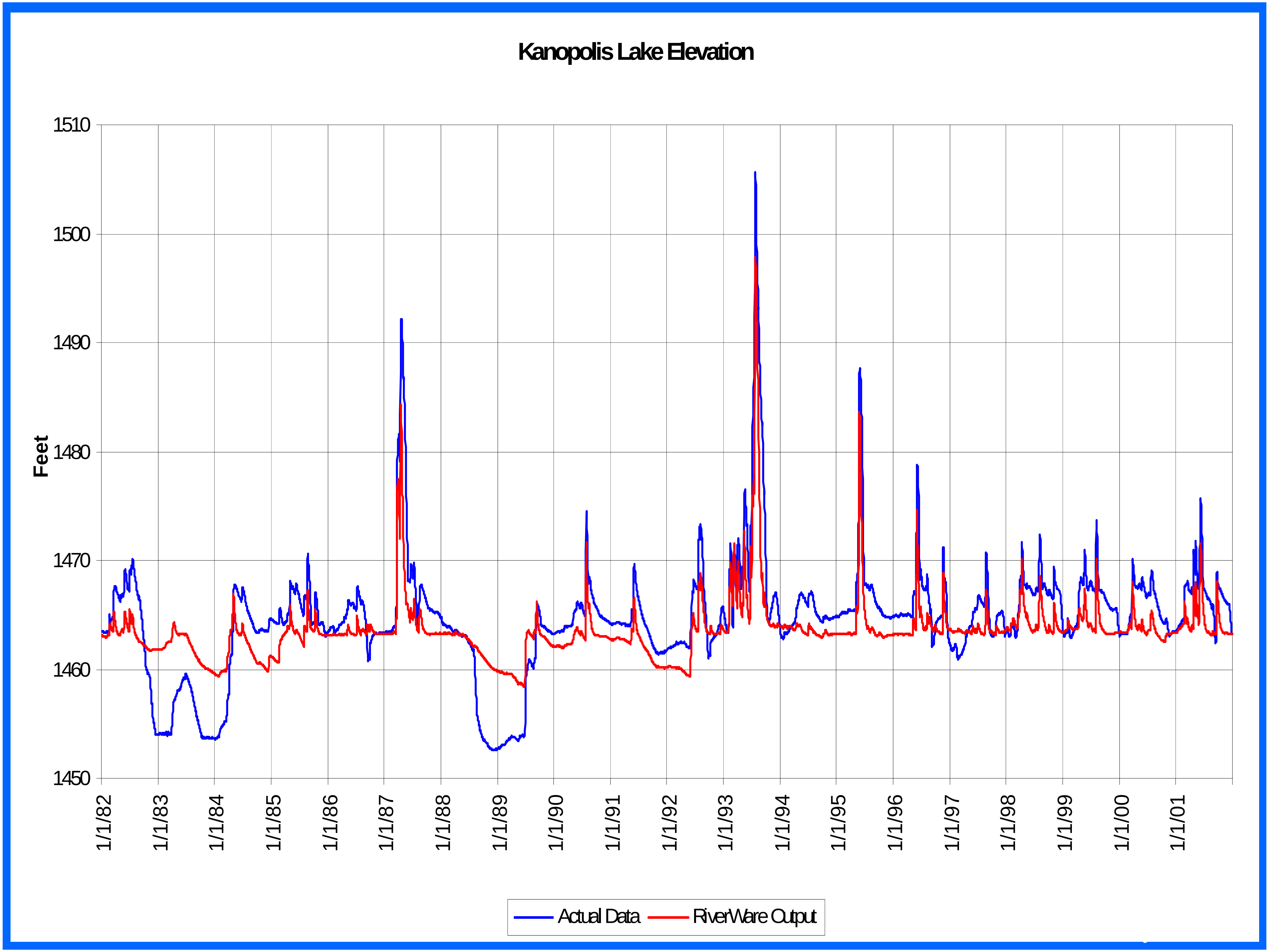
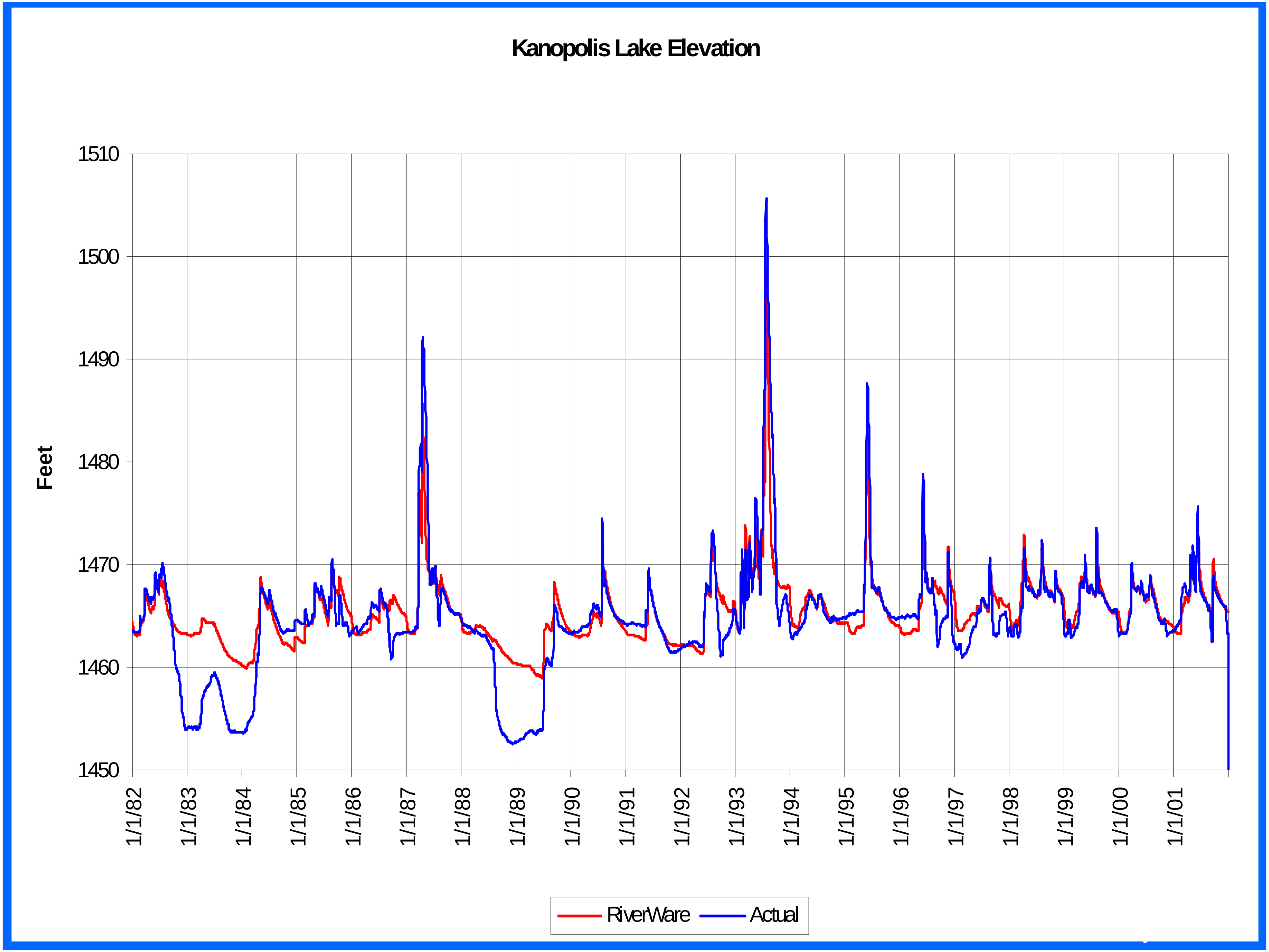
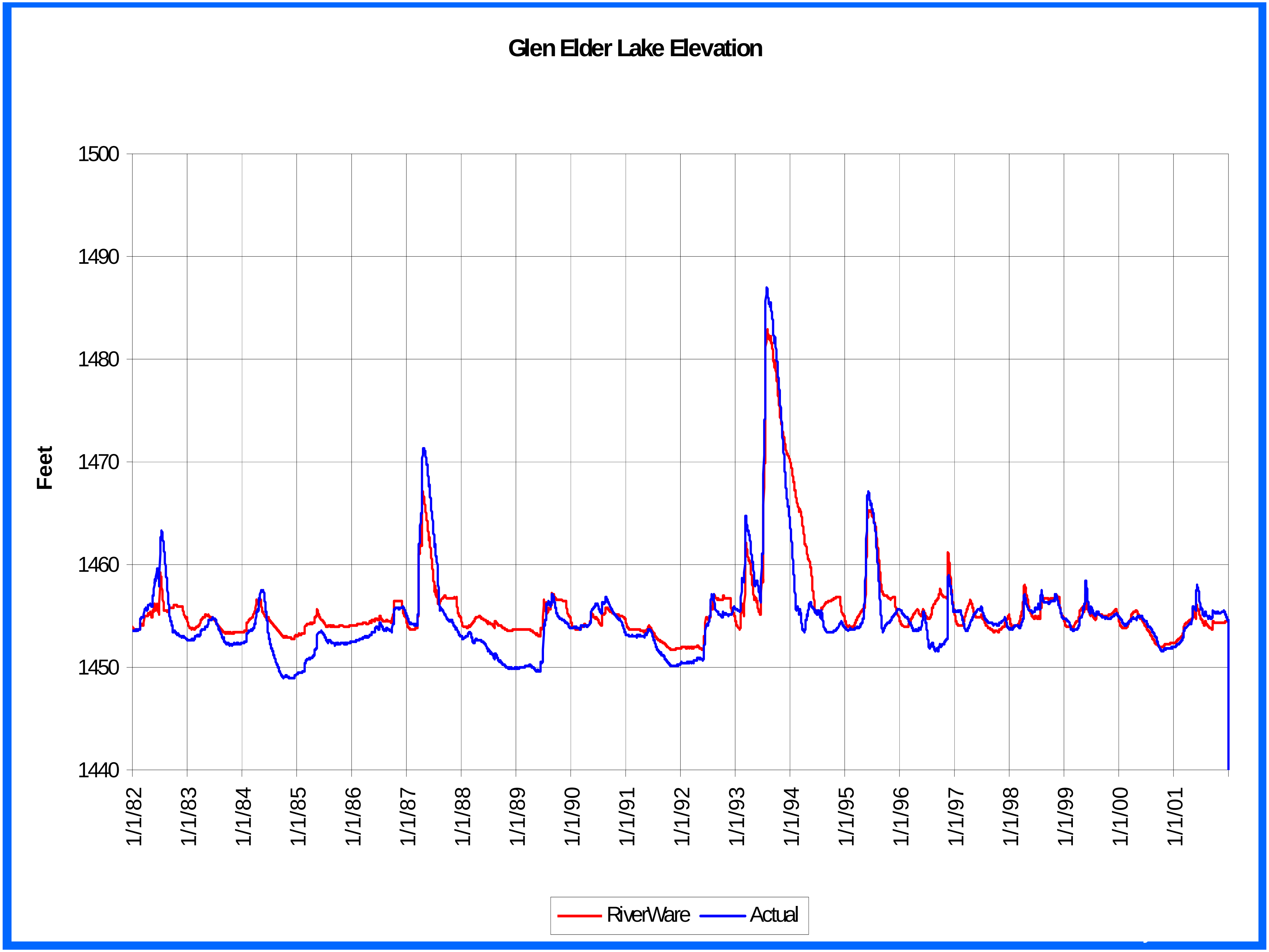
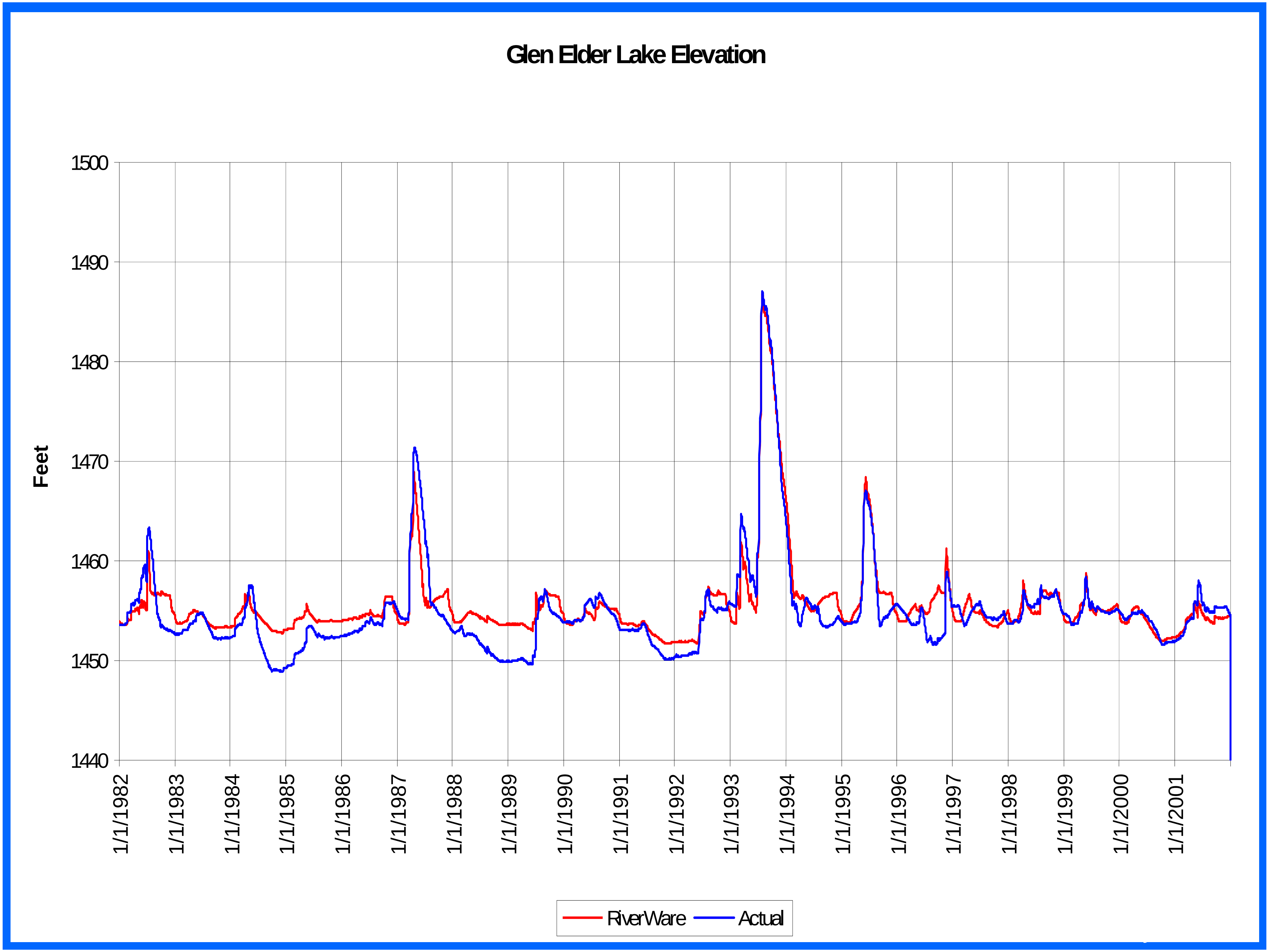


Kanopolis Lake Elevation
Feet
1510
1500
1490
1480
1470
1460
1450
1/1/82
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
Actual Data
RiverWare Output

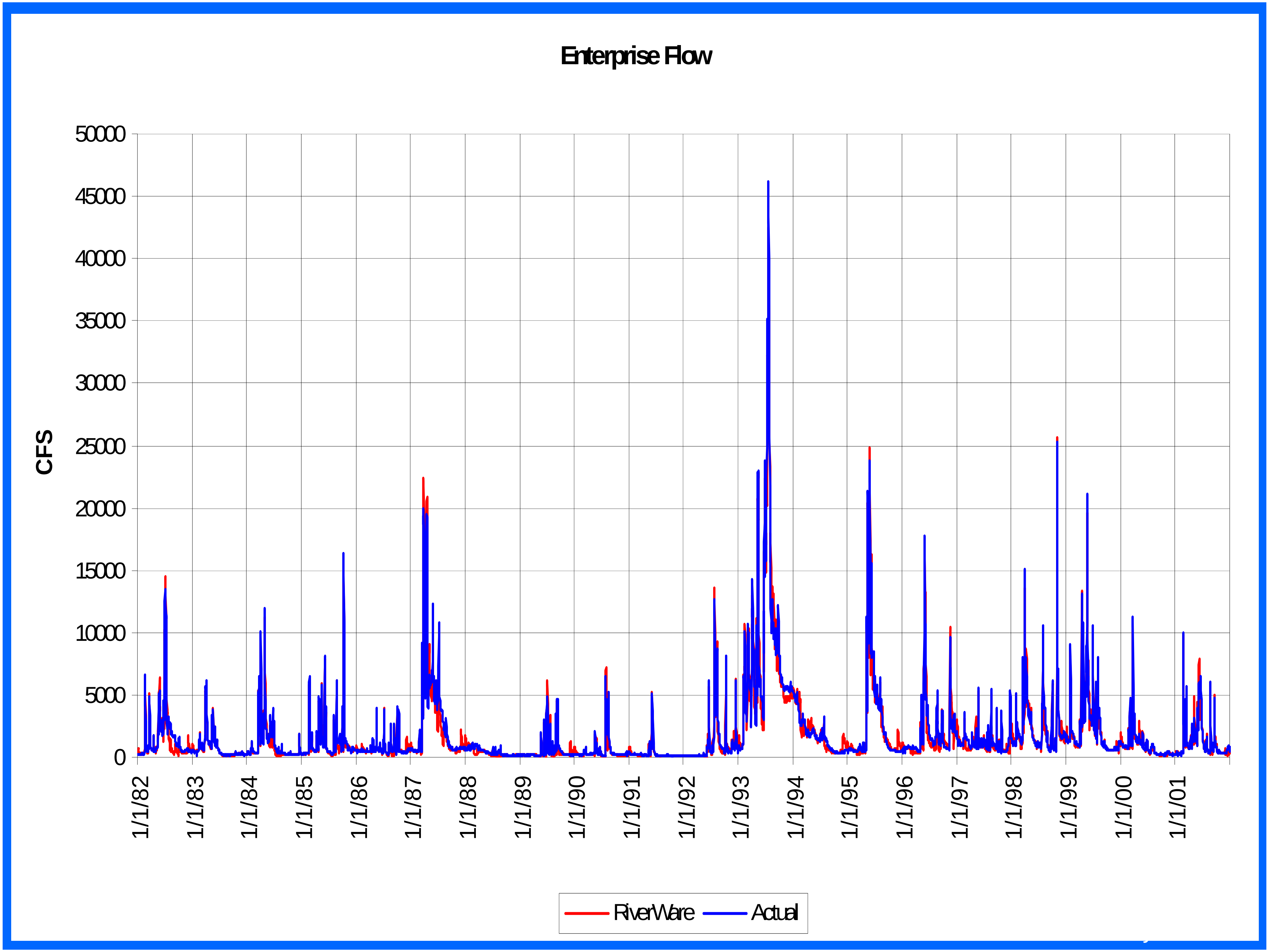


Kanopolis Lake Elevation
Feet
1510
1500
1490
1480
1470
1460
1450
1/1/82
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
RiverWare
Actual


Glen Elder Lake Elevation
Feet
1500
1490
1480
1470
1460
1450
1440
1/1/82
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
RiverWare
Actual



Glen Elder Lake Elevation
Feet
1500
1490
1480
1470
1460
1450
1440
1/1/1982
1/1/1983
1/1/1984
1/1/1985
1/1/1986
1/1/1987
1/1/1988
1/1/1989
1/1/1990
1/1/1991
1/1/1992
1/1/1993
1/1/1994
1/1/1995
1/1/1996
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
RiverWare
Actual



Enterprise Flow
CFS
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1/1/82
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
RiverWare
Actual

Model Limitations

- Time for execution
  - Smoky Basin – 20 Minutes
  - Kansas/Republican Basin – 2 Hours
- Depletion of flows
  - Farming practices
  - Groundwater development
- Does not incorporate upstream reservoirs
- Difficult to simulate older data

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Basin Lakes Not Modeled

In accordance with the PMP, many upstream lakes have not been included in the Model. Model lakes that have upstream flood control structures are:

Model Lake	Upstream Lake
KANS	Cedar Bluff
GLEL	Kirwin, Webster
HACO	Norton, Bonny, Swanson, Hugh Butler, Harry Strunk, and Enders

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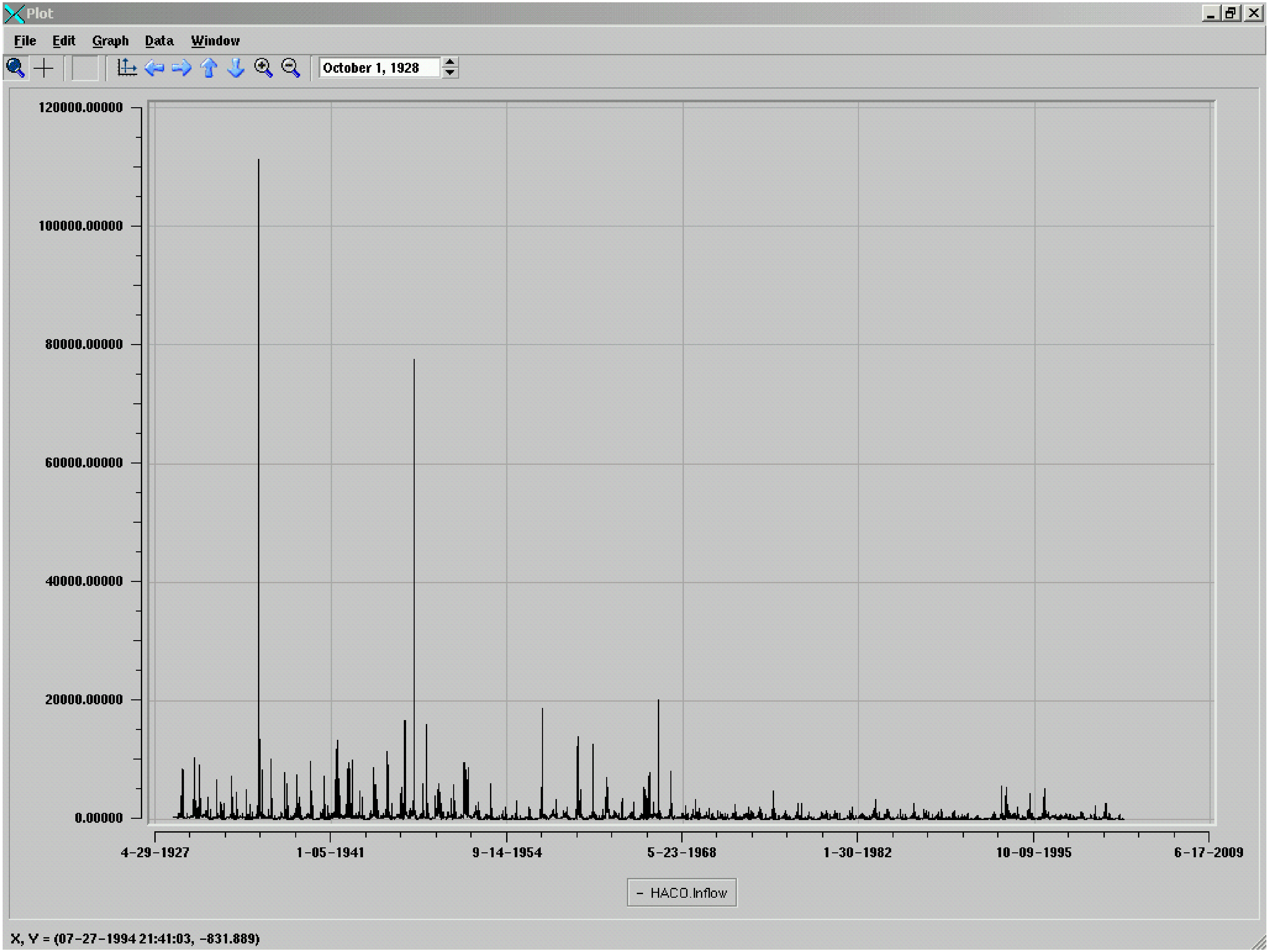
Kansas City District


Plot
File
Edit
Graph
Data
Window
October 1, 1928
120000.00000
100000.00000
80000.00000
60000.00000
40000.00000
20000.00000
0.00000
4-29-1927
1-05-1941
9-14-1954
5-23-1968
1-30-1982
10-09-1995
6-17-2009
HACO.Inflow
X, Y = (07-27-1994 21:41:03, -831.889)


RiverWare
C351-300-021198
Parker Dam

Edward Parker
816 983-3145
Kansas City District
U.S. Army Corps of Engineers
Edward.e.parker@usace.army.mil

US Army Corps
of Engineers
Kansas City District

SPILLWAY ADEQUACY ANALYSIS

OF

ROUGH RIVER LAKE

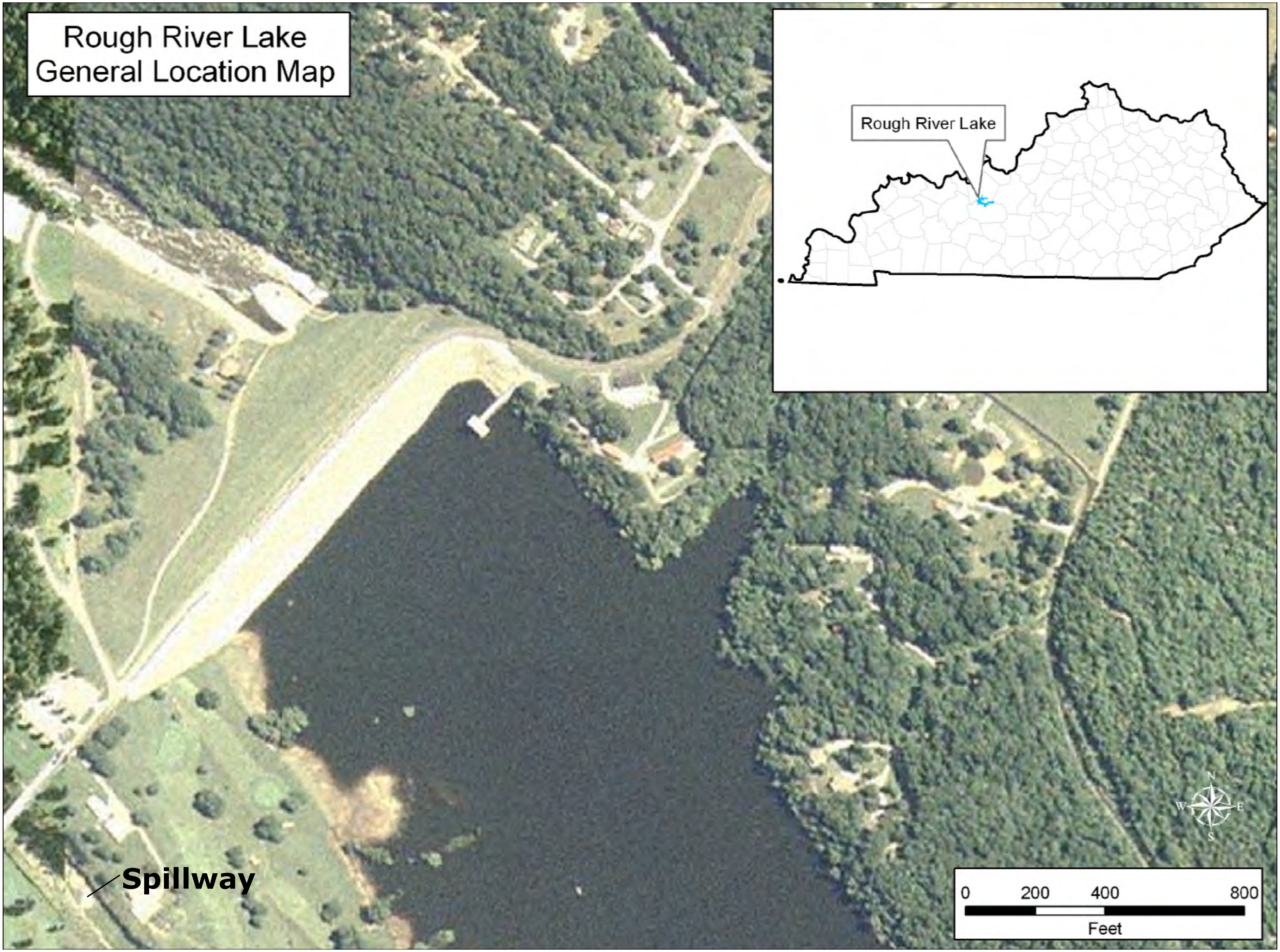
LOUISVILLE DISTRICT

RICHARD PRUITT

(502) 315-6380

Louisville District COE

richard.l.pruitt@lrl02.usace.army.mil


Rough River Lake
General Location Map
Rough River Lake
Spillway
N
S
W
E
0
200
400
800
Feet

ROUGH RIVER LAKE PERTINENT DATA

Construction Completed	Sept 1959
Spillway Crest	524 ft msl
Probable Maximum Flood	
Total Precip in 48 hrs	27.6 inches
Elevation of Pool at Start of flood (routing of 1937 flood)	503 ft msl
Maximum Water Surface Elevation	549.1 ft msl
Top of Dam	554.0 ft msl

Engineering Regulation 1110-8-2(FR)

Inflow Design Floods for Dams and Reservoirs

For Ohio River Basin – Antecedent Flood

30% of PMF w/ 3 Dry Days

or

39% of PMF w/ 5 Dry Days

Engineering Regulation 1110-2-1155

Dam Safety Assurance Program

Policy:

Dam Safety Modifications related to Hydrologic Deficiencies should be recommended to meet or exceed the Base Safety Condition (BSC).

The BSC is met when Dam failure will result in no significant increase in loss of life or economic damages compared to without Dam failure.

GUIDELINES

for

EVALUATING MODIFICATIONS OF EXISTING DAMS RELATED TO HYDROLOGIC DEFICIENCIES

OFFICE OF THE CHIEF OF ENGINEERS

U.S. Army Engineer
Institute for Water Resources
IWR Report 86-R-7

September 1986

EVALUATING MODIFICATIONS OF EXISTING DAMS RELATED TO HYDROLOGIC DEFICIENCIES

SEVENTEEN STEP PHASE

Steps 1-11

- Determine if the existing Dam is Hydrologically deficient based upon the latest IWR guidelines

Steps 12-17

- If these Dams are Hydrologically deficient, focus on the evaluation of alternative measures which can provide the required level of Dam safety.

Step 1 - Describe the Physical Project Characteristics

a) Summarize and display the physical features of the project

b) Describe the physical features of the project

c) Describe the operations and use of the project

d) Describe the economic development upstream and downstream of the Dam

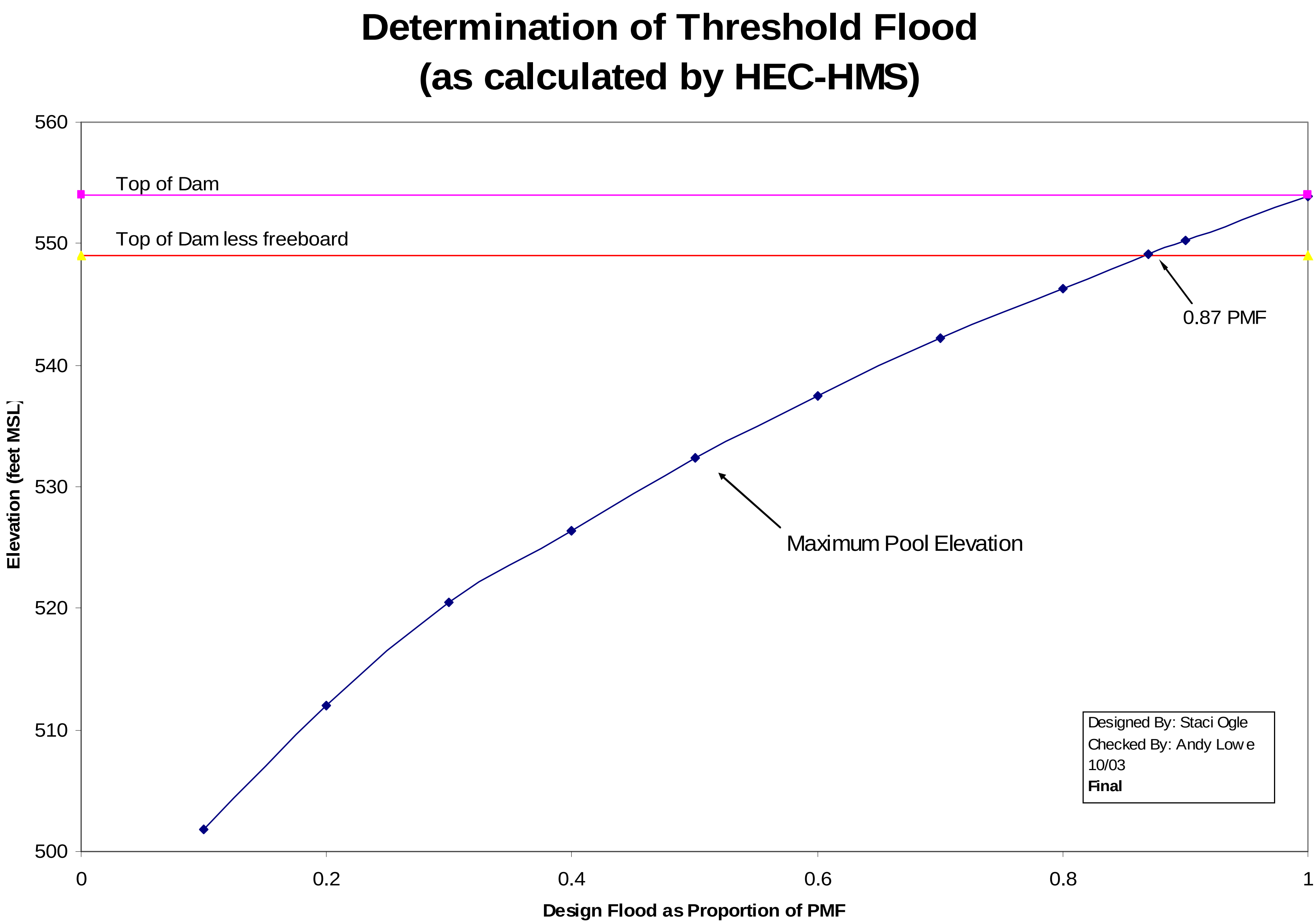
Step 2 - Determination of the Existing Threshold Flood

1) The Threshold flood is that flood that results in a peak lake water surface elevation equal to the top of Dam less appropriate freeboard. Expressed as % of the PMF.

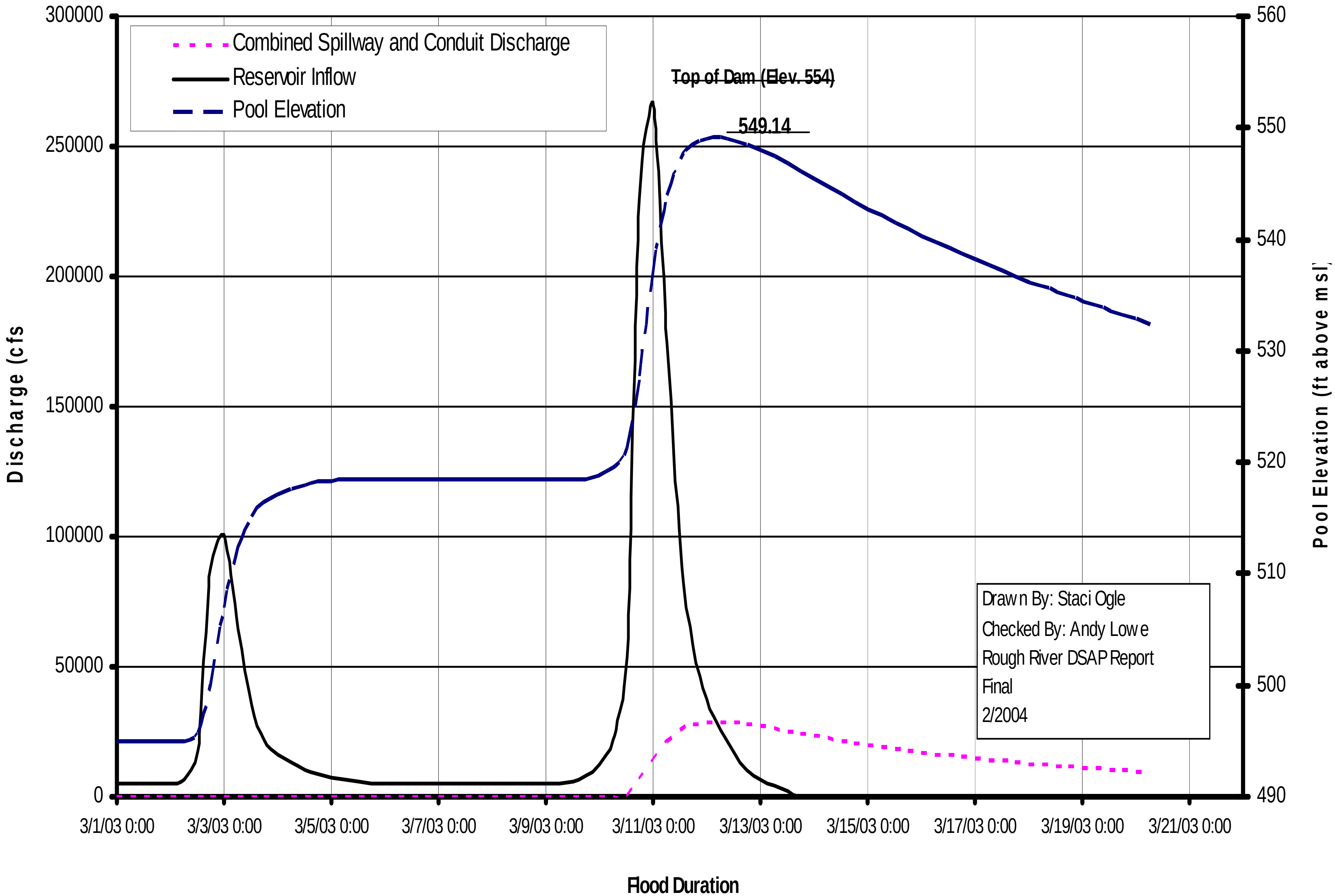
2) Assume an antecedent flood begins 5 days prior to the onset of the Threshold flood and is 50% of the following Threshold flood.

   or

   Assume antecedent flood is 30% of the Threshold flood with 3 days dry period or 39% of Threshold flood with 5 days dry period for Ohio River Basin.



Determination of Threshold Flood
(as calculated by HEC-HMS)
560
550
540
530
520
510
500
Elevation (feet MSL)
Top of Dam
Top of Dam less freeboard
0.87 PMF
Maximum Pool Elevation
Designed By: Staci Ogle
Checked By: Andy Lowe
10/03
Final
0
0.2
0.4
0.6
0.8
1
Design Flood as Proportion of PMF



Combined Spillway and Conduit Discharge
Reservoir Inflow
Pool Elevation
Top of Dam (Elev. 554)
549.14
Drawn By: Staci Ogle
Checked By: Andy Lowe
Rough River DSAP Report
Final
2/2004
Discharge (cfs
Pool Elevation (ft above msl)
300000
250000
200000
150000
100000
50000
0
560
550
540
530
520
510
500
490
3/1/03 0:00
3/3/03 0:00
3/5/03 0:00
3/7/03 0:00
3/9/03 0:00
3/11/03 0:00
3/13/03 0:00
3/15/03 0:00
3/17/03 0:00
3/19/03 0:00
3/21/03 0:00
Flood Duration

Step 3 - Determine total flows and downstream inundation elevations from the Threshold Flood "with and without" dam failure and from lesser floods.

The results of this step will be used to produce inundation maps for the evaluation of potential fatalities and economic losses.

DAM BREACH MODELS:

1. HEC-RAS
2. NWS DAMBRK
3. FLDWAV
4. HEC-1; HEC-HMS
5. BREACH

TRAINING:

October 25-27, 2005 Salt Lake City, Utah
FEMA/ Association of State Dam Safety Officials
Susan Sorrell (859) 257-5146

Dam Break Model Parameters

Initial Reservoir Water Surface Elevation	495 (Summer Pool)
Water Surface Elevation at Time of Breach	554 (Top of Dam)
Breach Side Slope	1:1
Stream Bed Elevation	424
Final Breach Bottom Elevation	424
Breach Base Width	300 feet
Time of Breach Formation	6 hours

Step 4 – Compute the hypothetical maximum Dam failure flows and downstream inundation elevations.

Purpose – To determine the maximum lateral boundaries for the collection of data on economic and life losses for the succeeding steps.

Step 5 – Prepare inundation maps and collect data on damageable property and populations for the hypothetical maximum flooding determined in Step 4.

PURPOSE – Requires the collection of data for use in estimating economic flood losses and life losses.

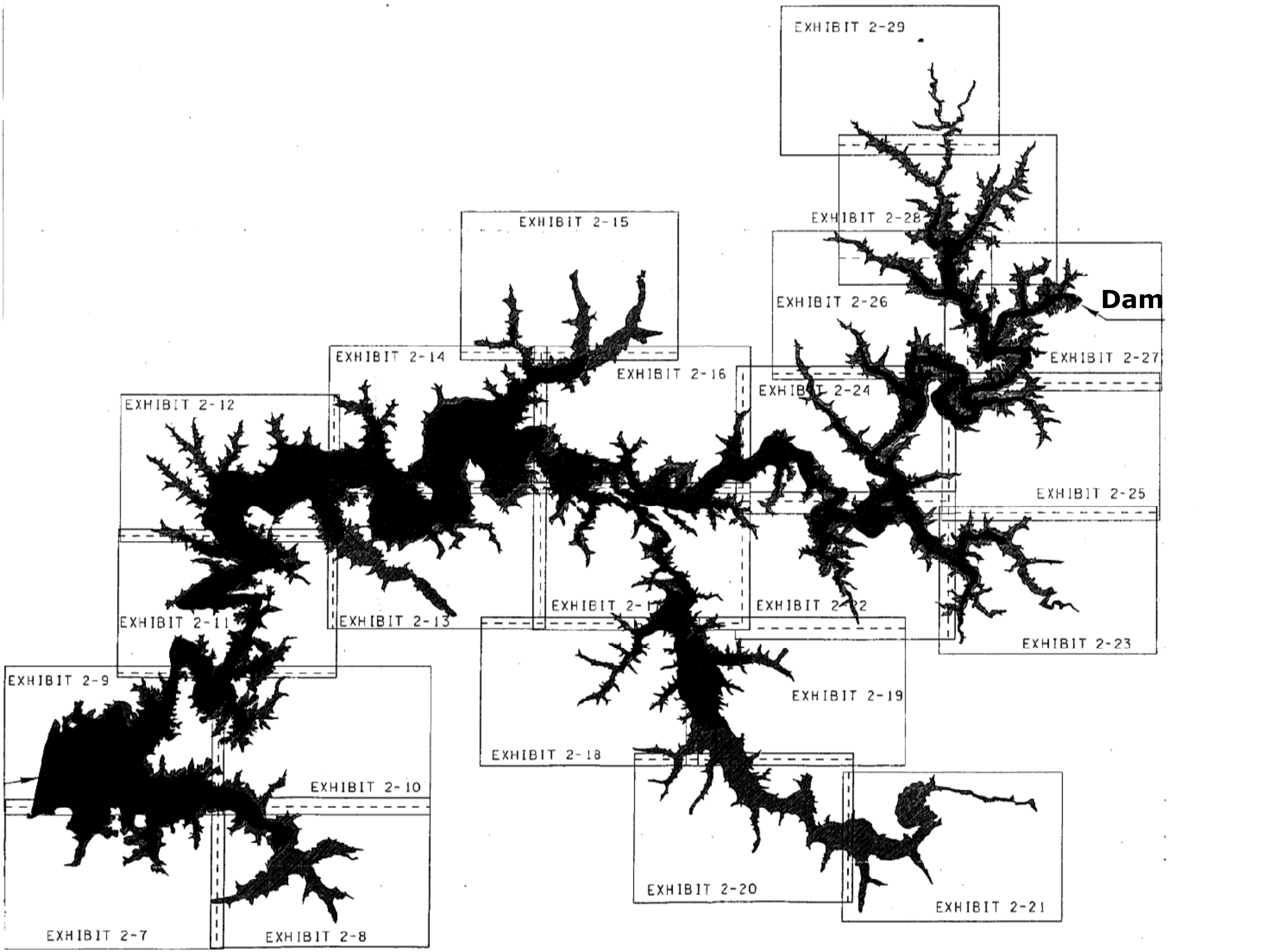


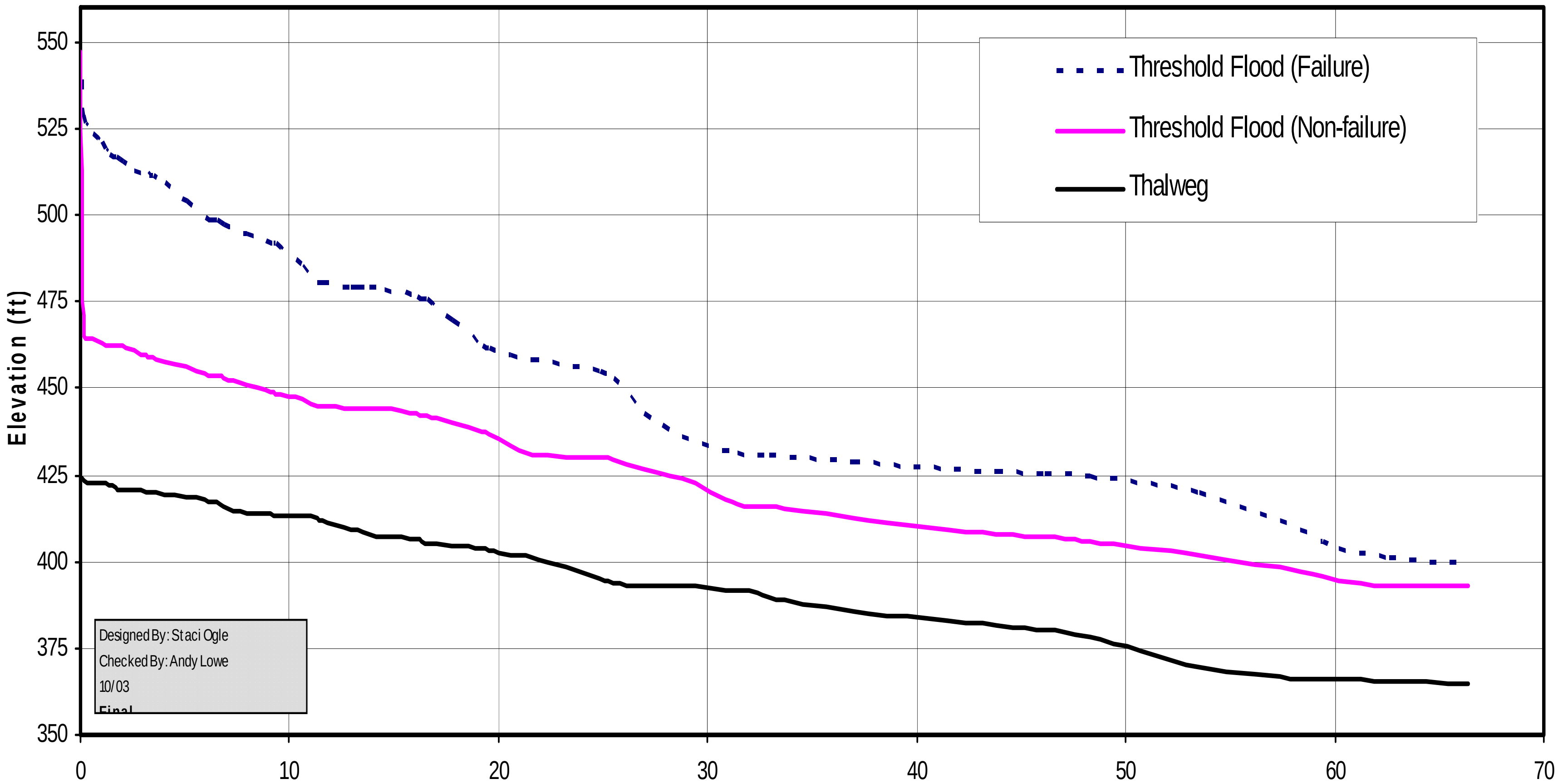
EXHIBIT 2-29
EXHIBIT 2-28
EXHIBIT 2-15
EXHIBIT 2-26
Dam
EXHIBIT 2-27
EXHIBIT 2-14
EXHIBIT 2-16
EXHIBIT 2-24
EXHIBIT 2-12
EXHIBIT 2-25
EXHIBIT 2-22
EXHIBIT 2-11
EXHIBIT 2-13
EXHIBIT 2-23
EXHIBIT 2-9
EXHIBIT 2-19
EXHIBIT 2-18
EXHIBIT 2-10
EXHIBIT 2-20
EXHIBIT 2-21
EXHIBIT 2-7
EXHIBIT 2-8

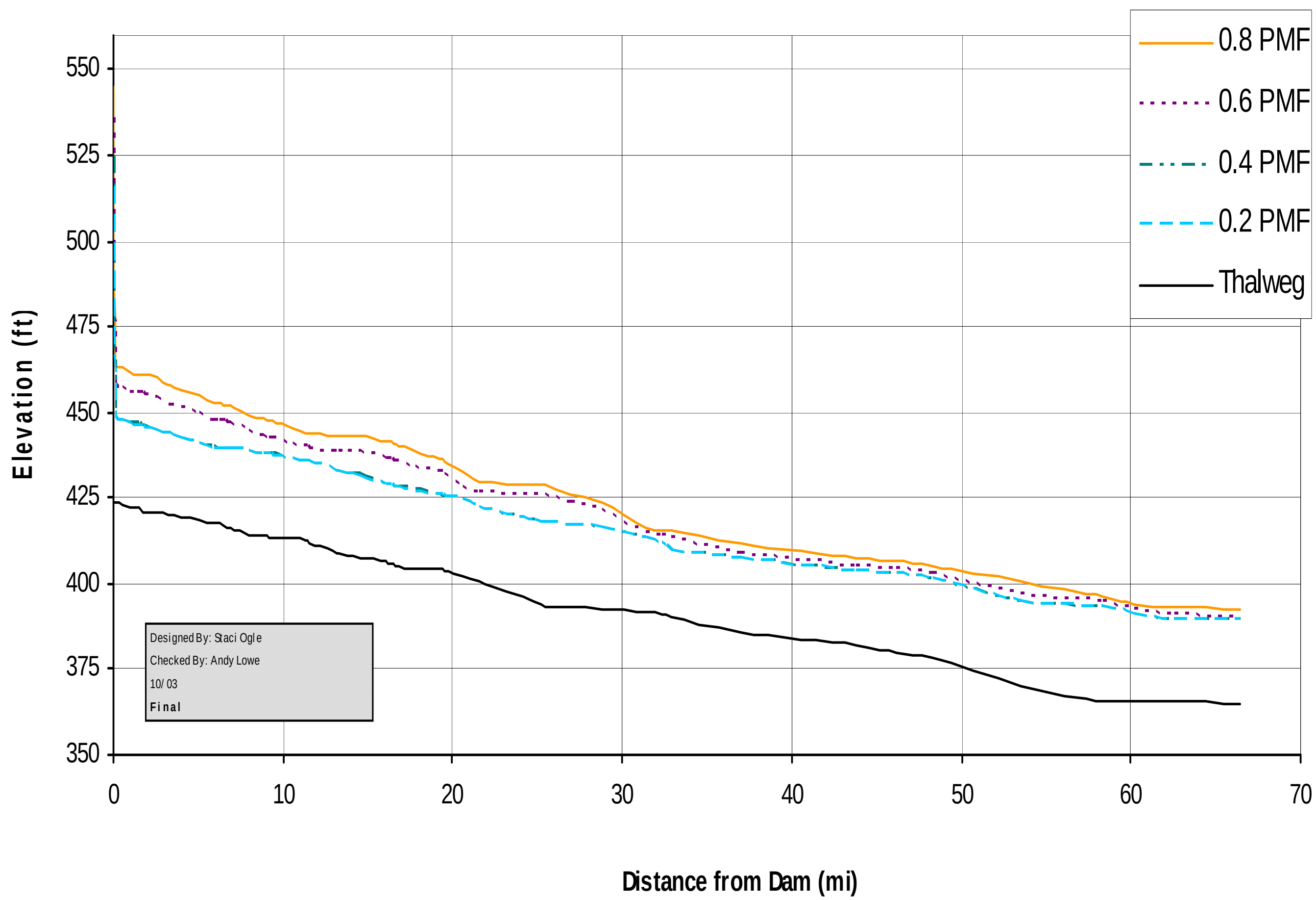
Study:	Rough River						
Description:	Rough River Dam Safety Study						
Pathname:	C:\Documents and Settings\h2pmpklm\My Documents\HEC\FDA\Rough River						
Plan:	Without						
Year:	2003						
Struc_Name	Stream_Name		Station	Bank	Year	Cat_Name	Occ_Name
Structure Name	Stream Name	Reach Name	Station	Bank	Year In Service	Damage Category	Occupancy
1	Rough River	Gray-Co	0.16	Left	-901	PUBLIC	PUBL
2	Rough River	Gray-Co	0.16	Left	-901	PUBLIC	PUBL
3	Rough River	Gray-Co	0.2	Left	-901	PUBLIC	PUBL
4	Rough River	Gray-Co	5.2	Left	-901	Residential	7
5	Rough River	Gray-Co	5.2	Left	-901	Residential	2
6	Rough River	Gray-Co	5.2	Left	-901	Residential	5
7	Rough River	Gray-Co	5.2	Left	-901	COMM	WARE
8	Rough River	Gray-Co	5.2	Left	-901	Residential	2
9	Rough River	Gray-Co	5.3	Left	-901	Residential	1
10	Rough River	Gray-Co	5.4	Left	-901	Residential	7
11	Rough River	Gray-Co	5.4	Left	-901	Residential	7

Step 6 – Prepare inundation maps for the Threshold flood with & without Dam failure.

This information will be used to determine economic flood losses and the population threatened by failure and non-failure floods.

Existing Condition Inundation Elevation for the Threshold Flood
Dam Failure and Dam Non-failure
(as calculated by Boss DamBrk Program)





0.8 PMF
0.6 PMF
0.4 PMF
0.2 PMF
Thalweg
Elevation (ft)
550
525
500
475
450
425
400
375
350
0
10
20
30
40
50
60
70
Distance from Dam (mi)
Designed By: Staci Ogle
Checked By: Andy Lowe
10/03
Final

Step 7 – Determine population at risk (PAR) from the Threshold flood and lesser events.

Population at Risk defined as all persons that would be exposed to flood waters if they took no measures to evacuate.

PAR will be used to estimate the Threatened Population (TP) and Loss of Life (LOL).

PAR varies for time of day (daily transients).
PAR varies for time of year (seasonal transients).

ROUGH RIVER LAKE

Average daily traffic counts were obtained in the study area for both low-severity zones and medium-severity zones to estimate transient motorist population at risk.

Step 8 – Determine economic losses from Threshold flood and specified lesser floods.

If economic losses are significantly greater with Dam failure than losses without failure, an investment to improve the safety of the Dam may be warranted.

TYPES OF LOSSES:

a) Residential structure & contents
b) Commercial and industrial structure & contents
c) Agricultural losses
d) Income losses
e) Damage to utilities, transportation & communication systems
f) Vehicles
g) Flood emergency costs
h) Project benefits lost with failure
i) Culture & environmental assets
j) Physical & psychological injuries

	Dam Non-failure	Dam Failure
Total PAR	139	1,367
Total Econ. Losses	$1,867,000	$17,833,000

Step 9 – Determination of Dam failure warning time.

The estimated warning time will be used to estimate the threatened population in step 10 as well as the loss of life.

Threatened Population – all those likely to be exposed to floodwaters assuming that warnings have been issued.

ROUGH RIVER LAKE ANALYSIS

The minimum warning time for a potential Dam failure is greater than 60 minutes.

Step 10 – Estimate the baseline probable PAR, probable TP, and probable LOL from the Threshold flood and specified lesser floods.

At the time of this IWR report, it is stated "There is no generally accepted method of estimating the effectiveness of warning to calculate the probable TP and probable LOL."

Flood Severity	Warning Time (min)	Flood Severity Understanding*	Fatality Rate (Fraction of People at Risk Expected to Die)	
			Suggested	Suggested Range
High	No Warning	N/A	0.75	0.30 to 1.00
	15 to 60	Vague	Use the values shown above and apply to the number of people who remain in the dam failure floodplain after warnings are issued. No guidance is provided on how many people will remain in the floodplain.	
		Precise		
	More than 60	Vague		
		Precise		
Medium	No Warning	N/A	0.15	0.03 to 0.35
	15 to 60	Vague	0.04	0.01 to 0.08
		Precise	0.02	0.005 to 0.04
	More than 60	Vague	0.03	0.005 to 0.06
		Precise	0.01	0.002 to 0.02
Low	No Warning	N/A	0.01	0.0 to 0.02
	15 to 60	Vague	0.007	0.0 to 0.015
		Precise	0.002	0.0 to 0.004
	More than 60	Vague	0.0003	0.0 to 0.0006
		Precise	0.0002	0.0 to 0.0004

Bureau of Reclamations

*It was assumed that half the PAR would have a vague understanding of the resulting flood severity and the other half would have a precise understanding.

Step 11 – Display existing condition results and propose additional action.

If there is a significant increment in economic losses or probable LOL due to Dam failure, additional study of alternatives to reduce the extent of the Dam safety hazard is warranted.

	Dam Non-failure	Dam Failure
Total PAR	139	1,367
Total Econ. Losses	$1,867,000	$17,833,000

Step 12 – Identify alternatives to reduce the Dam safety hazard to people and property.

Alternatives should be based on percentages of the PMF, such as .80, .90 and 1.00 PMF.

ALTERNATIVES COULD INCLUDE:

a) Raising the top of Dam
b) Lowering/widening the Spillway
c) Reallocation of Reservoir storage
d) Permanent relocation of downstream population
e) Additional reservoirs
f) Additional Spillway capacity
g) FWEEPS

LIST OF ROUGH RIVER LAKE ALTERNATIVES

- Widen spillway
- Raise Dam in combination with wall
- Use Fusegates to lower spillway
- Combination of fusegates and wall

Step 13 – Evaluate the costs of BSC modification alternatives.

	Total Cost
Widen spillway by 85 feet	$5,109,500
Raise dam by 2 feet; construct 3-foot parapet wall across upstream crest	$1,433,000
Deepen spillway by 20 feet; install Fusegates	$3,896,500
Deepen spillway by 10 feet; install Fusegates construct 3-foot parapet wall	$3,147,700

Step 14 – Evaluate alternatives in terms of their effectiveness in reducing the hazard.

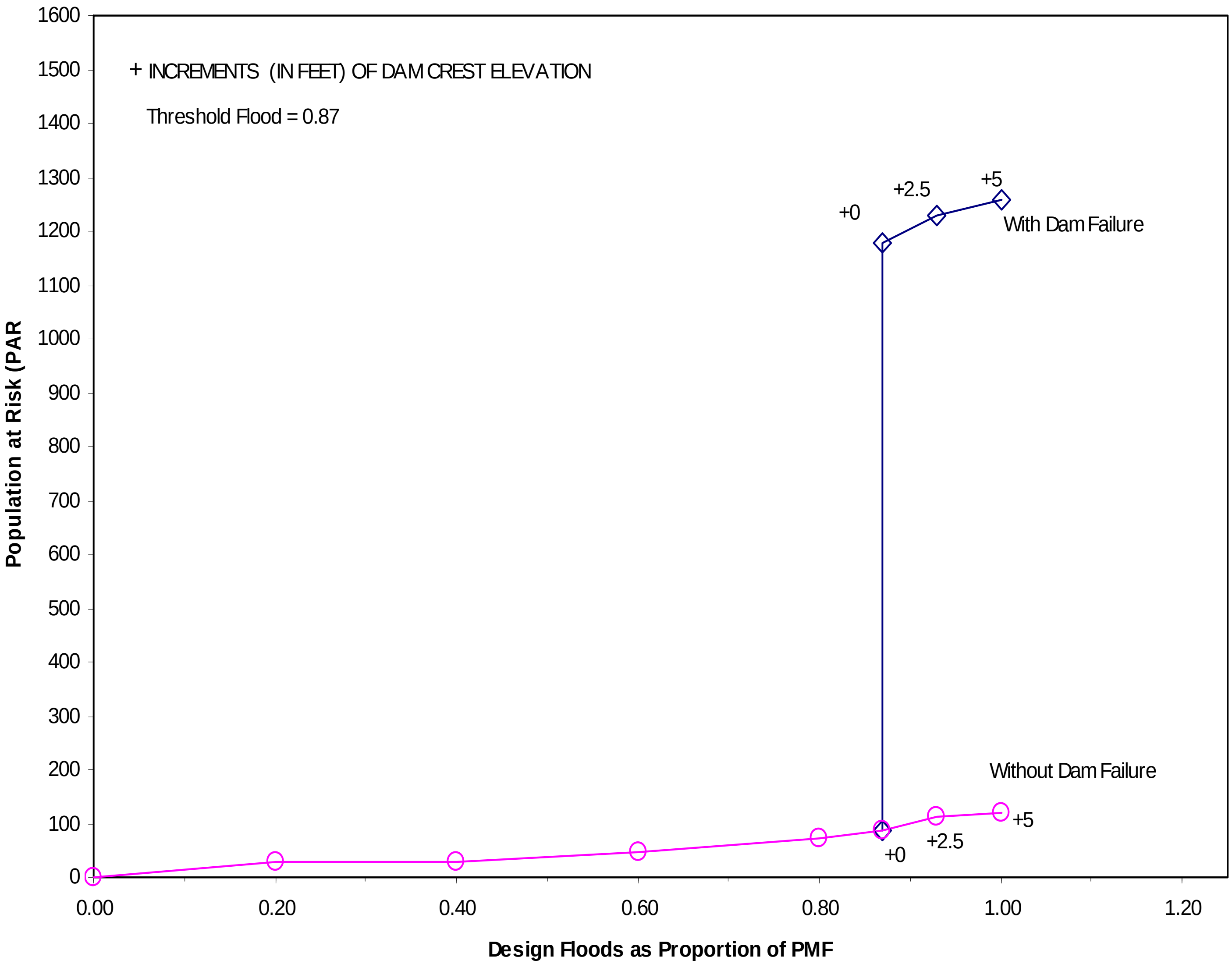
The method used for evaluating the alternatives follows the same steps as existing conditions as listed in steps 3-11.

Their effectiveness is measured in PAR and economic losses.

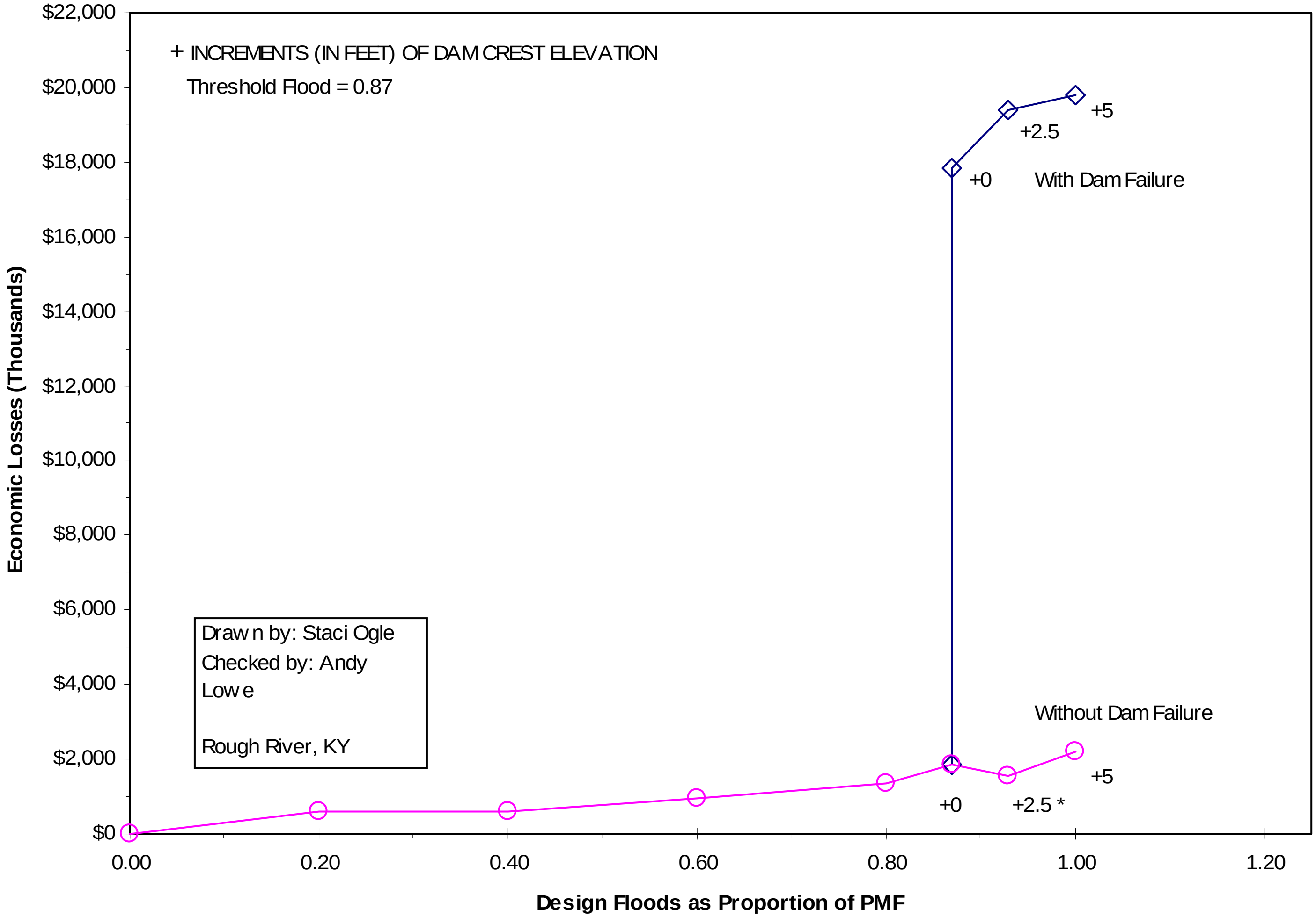
Step 15 – Determination of the Base Safety Condition (BSC).

If there is a significant increment in economic & probable LOL losses at the Threshold Flood, The Dam must be designed to safely pass a larger flood that meets a Base Safety Condition (BSC).

BSC-Flood event where there is no significant increase in loss of life or economic losses from Dam failure compared to without Dam failure.



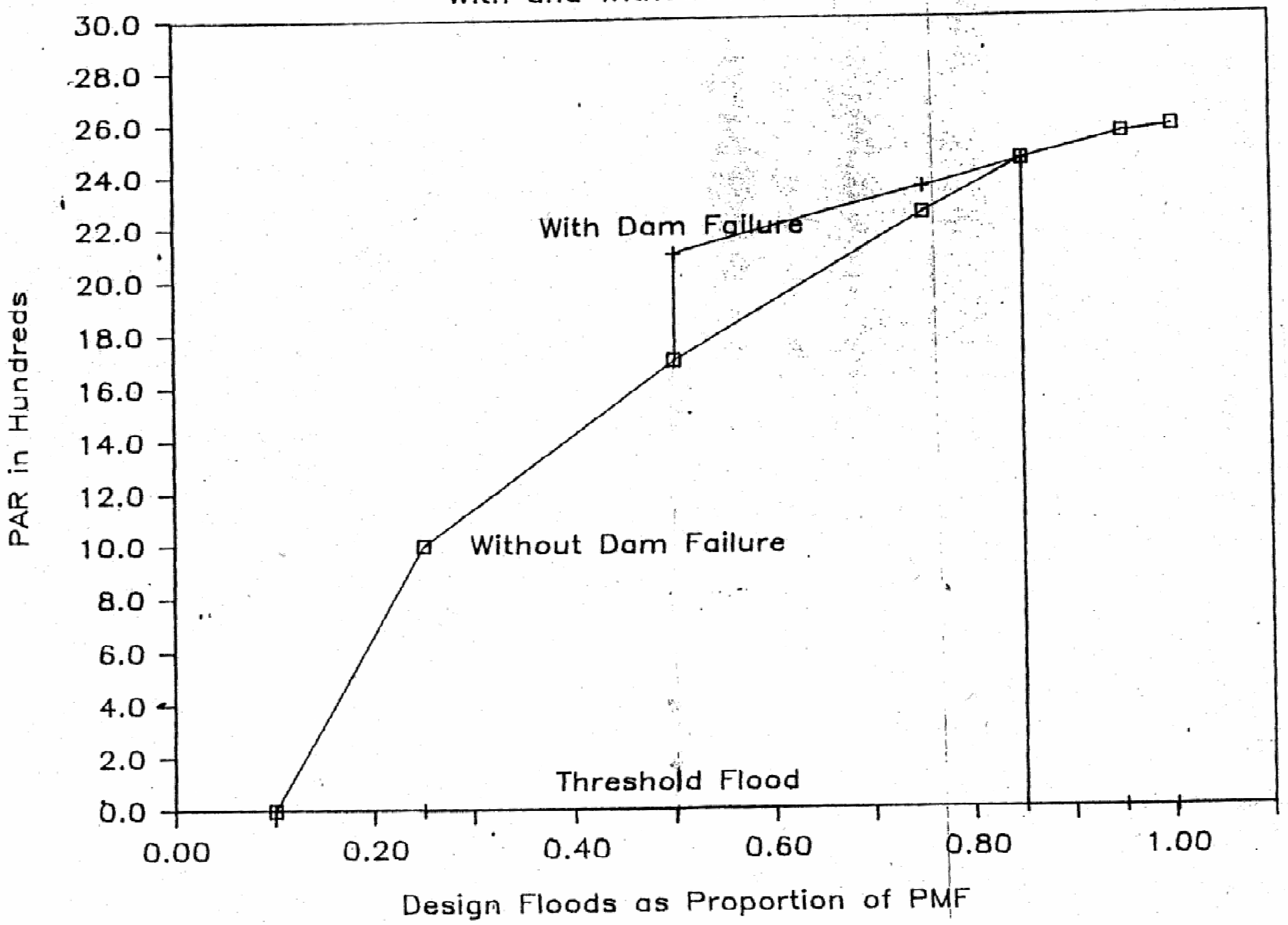
+ INCREMENTS (IN FEET) OF DAM CREST ELEVATION
Threshold Flood = 0.87
+0
+2.5
+5
With Dam Failure
Without Dam Failure
+5
+2.5
+0
Population at Risk (PAR
Design Floods as Proportion of PMF
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20



+ INCREMENTS (IN FEET) OF DAM CREST ELEVATION
Threshold Flood = 0.87
+5
+2.5
+0
With Dam Failure
Drawn by: Staci Ogle
Checked by: Andy Lowe
Rough River, KY
Without Dam Failure
+5
+0
+2.5 *
Economic Losses (Thousands)
$22,000
$20,000
$18,000
$16,000
$14,000
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Design Floods as Proportion of PMF

Figure III—9

With and Without Failure PAR

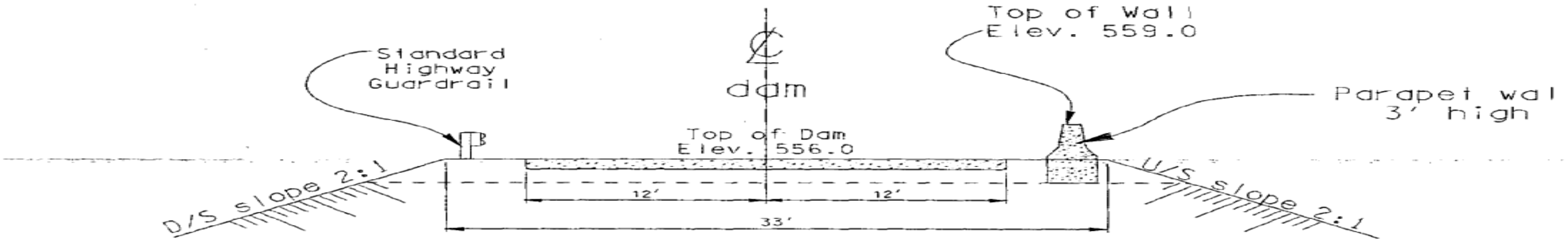


Step 16 – Recommend Choice of alternatives to meet BSC.

In general, the lowest-cost alternative meeting the BSC should be recommended for implementation. The BSC, by definition, is never greater than the PMF.

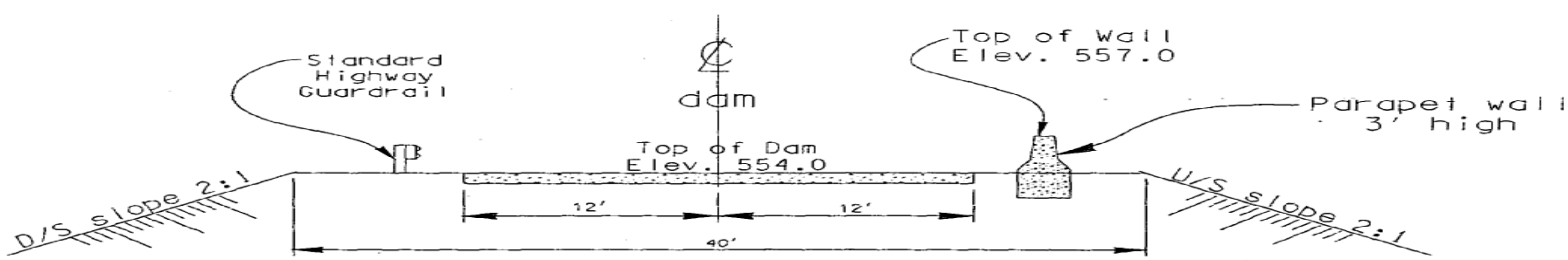
Provide a summary of the documentation of the evaluation process and to recommend a Dam safety modification for implementation.

WITH RAISING TOP OF DAM/ROAD



DETAIL SECTION OF TOP OF DAM

WITHOUT RAISING TOP OF DAM/ROAD



DETAIL SECTION OF TOP OF DAM

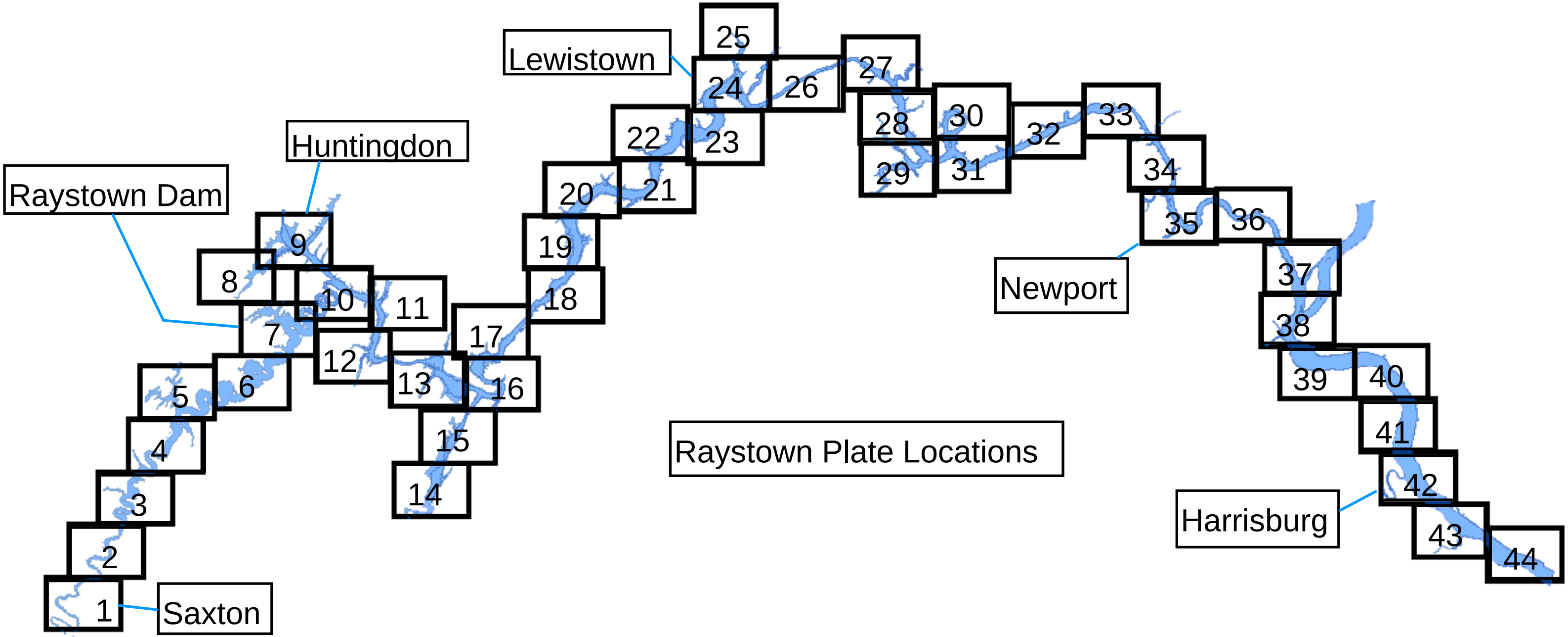
Step 17 – Determination of whether breaching the Dam should be evaluated as an alternative.

If the benefits of continued operation of the lake project do not exceed the costs for modification, consideration should be given to breaching the Dam.

ROUGH RIVER LAKE
RECOMMENDED MODIFICATION

Cost = $1,433,000

Benefit to Cost Ratio = 76 to 1


Raystown Plate Locations
Saxton
Raystown Dam
Huntingdon
Lewistown
Newport
Harrisburg
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
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21
22
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27
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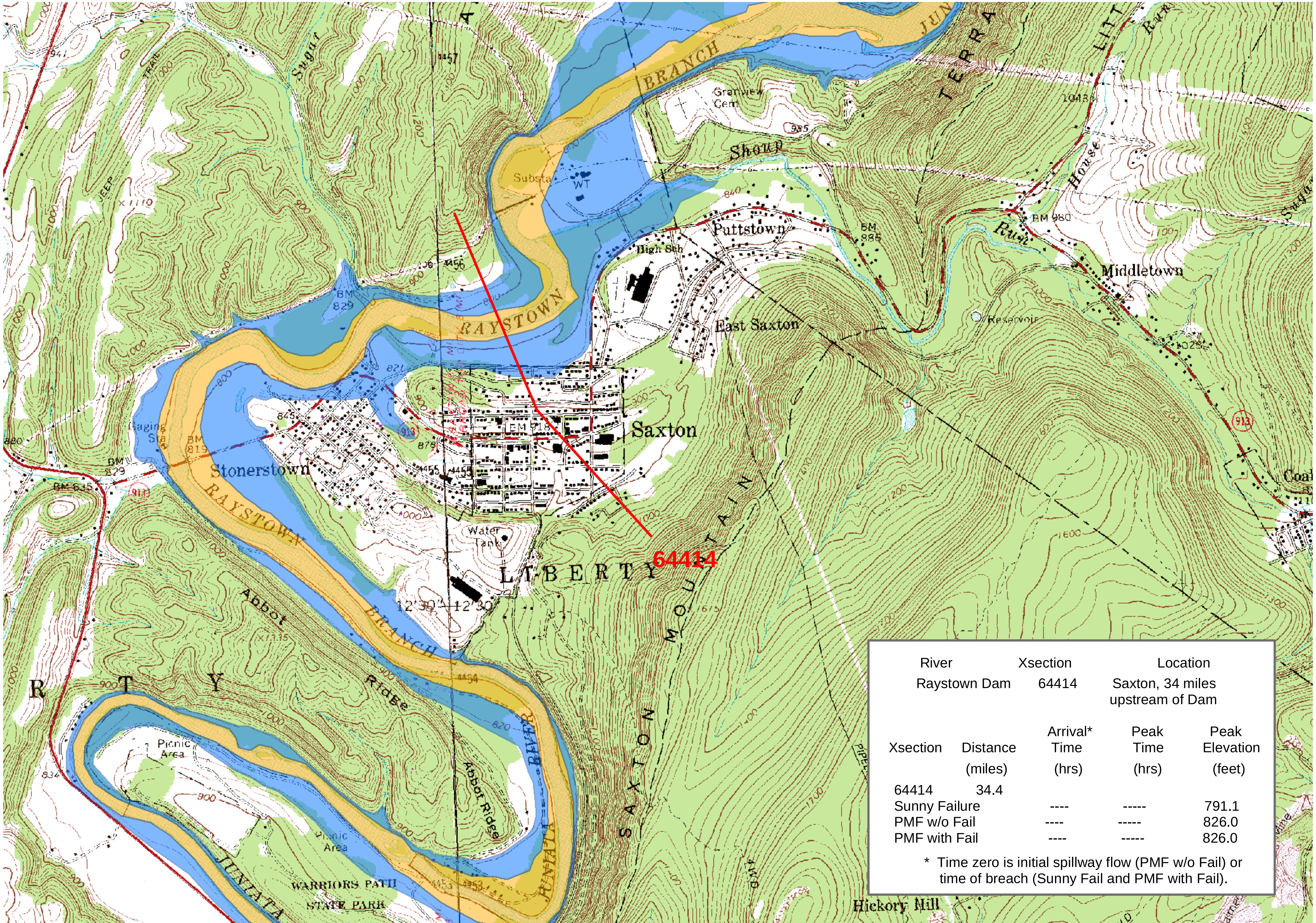
43
44

matches plate 2



River	Xsection	Location
Raystown Dam	64414	Saxton, 34 miles upstream of Dam

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
64414	34.4			
Sunny Failure		----	-----	791.1
PMF w/o Fail		----	-----	826.0
PMF with Fail		----	-----	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

end of study

N

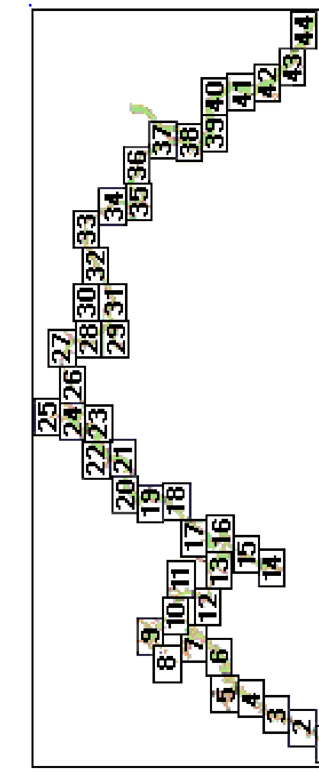
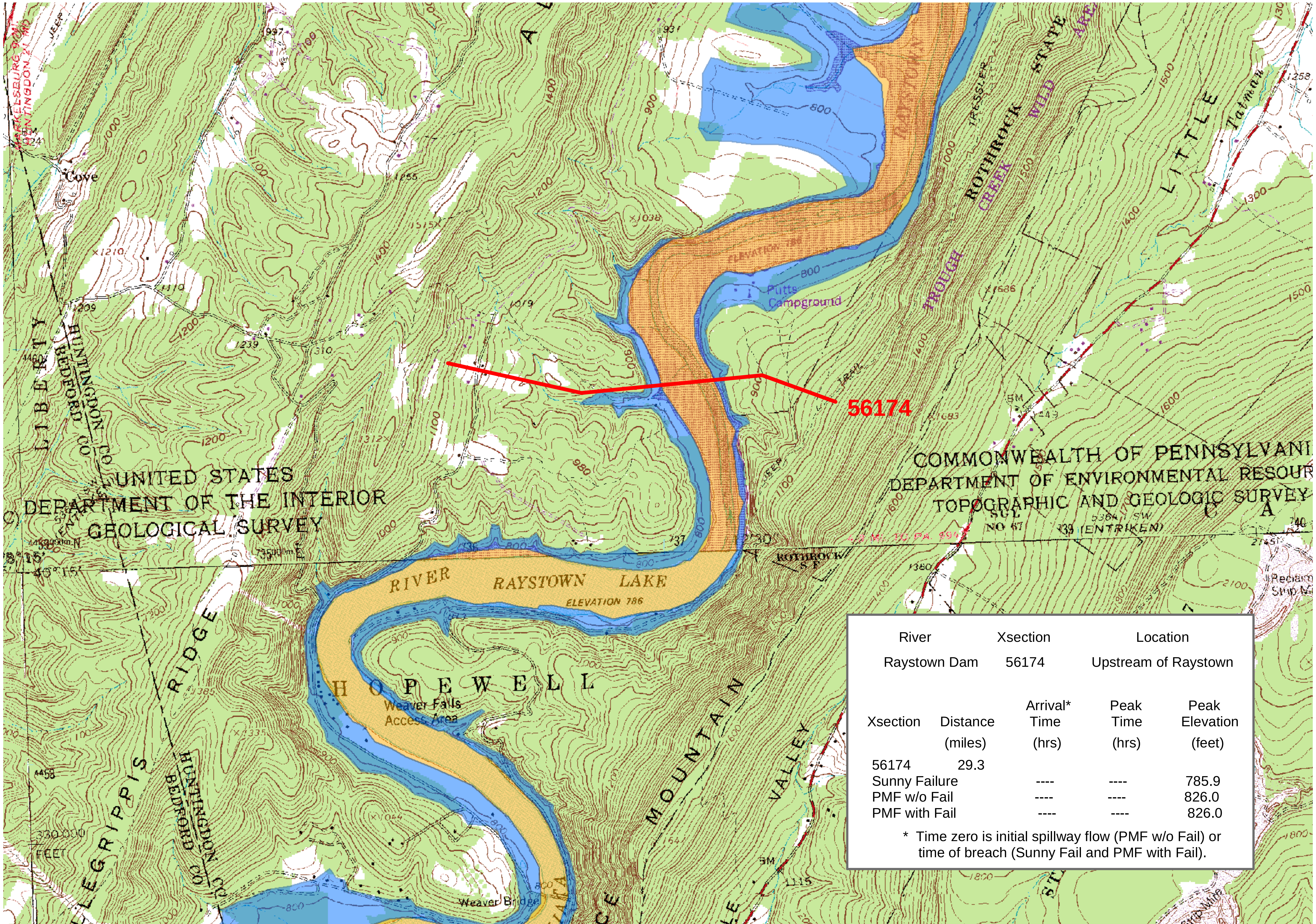


Plate 1

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 3



River	Xsection	Location
Raystown Dam	56174	Upstream of Raystown

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
56174	29.3			
Sunny Failure		----	----	785.9
PMF w/o Fail		----	----	826.0
PMF with Fail		----	----	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 1

N

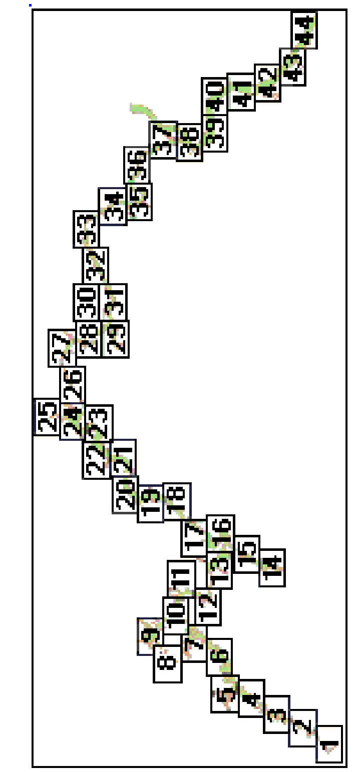
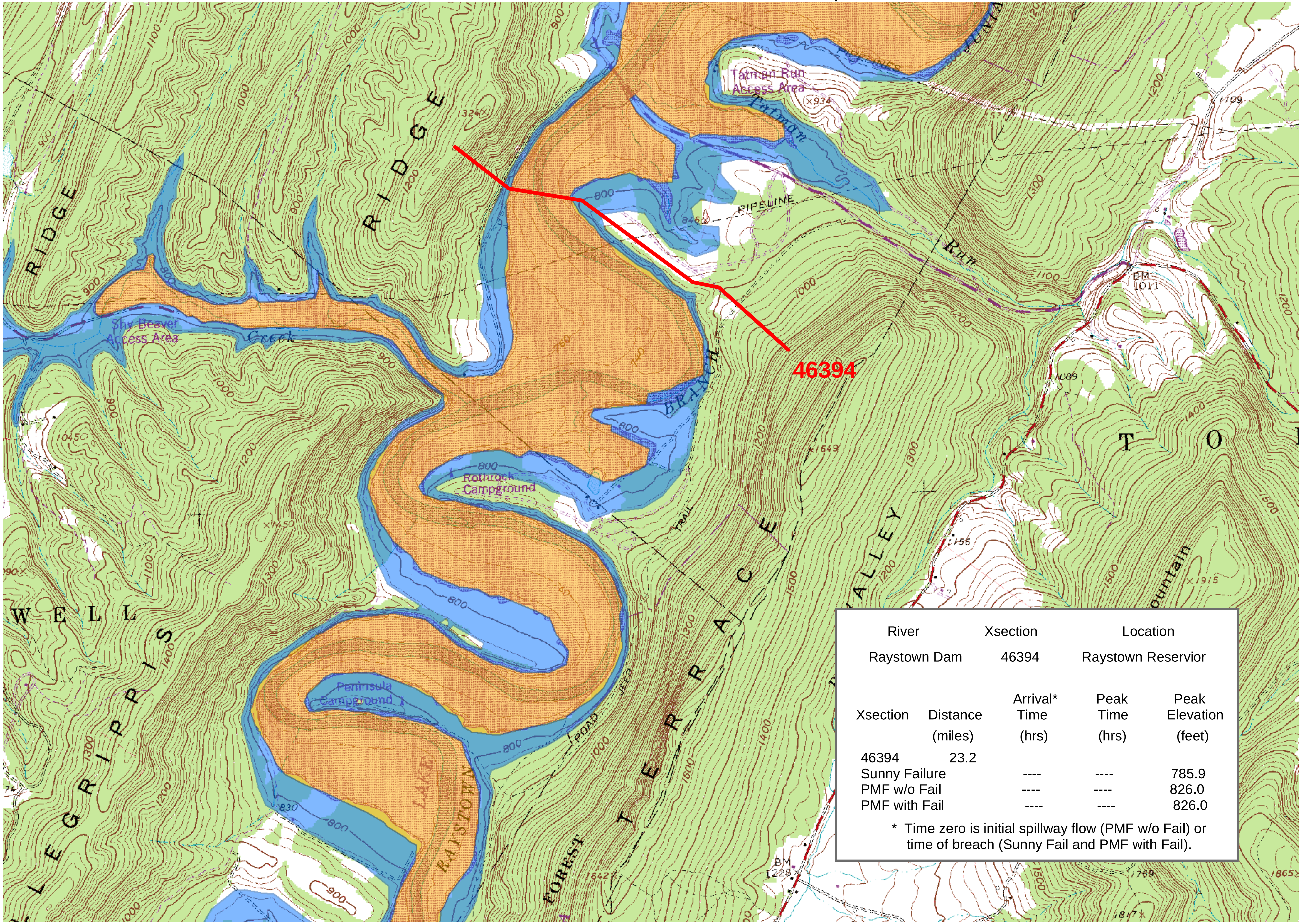


Plate 2

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 4



River	Xsection	Location
Raystown Dam	46394	Raystown Reservior

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
46394	23.2			
Sunny Failure		----	----	785.9
PMF w/o Fail		----	----	826.0
PMF with Fail		----	----	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 2

N

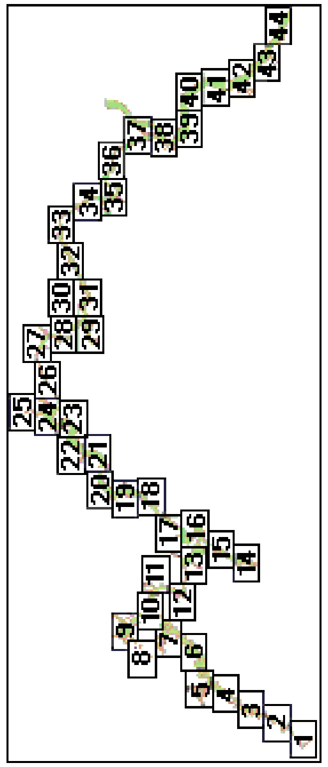
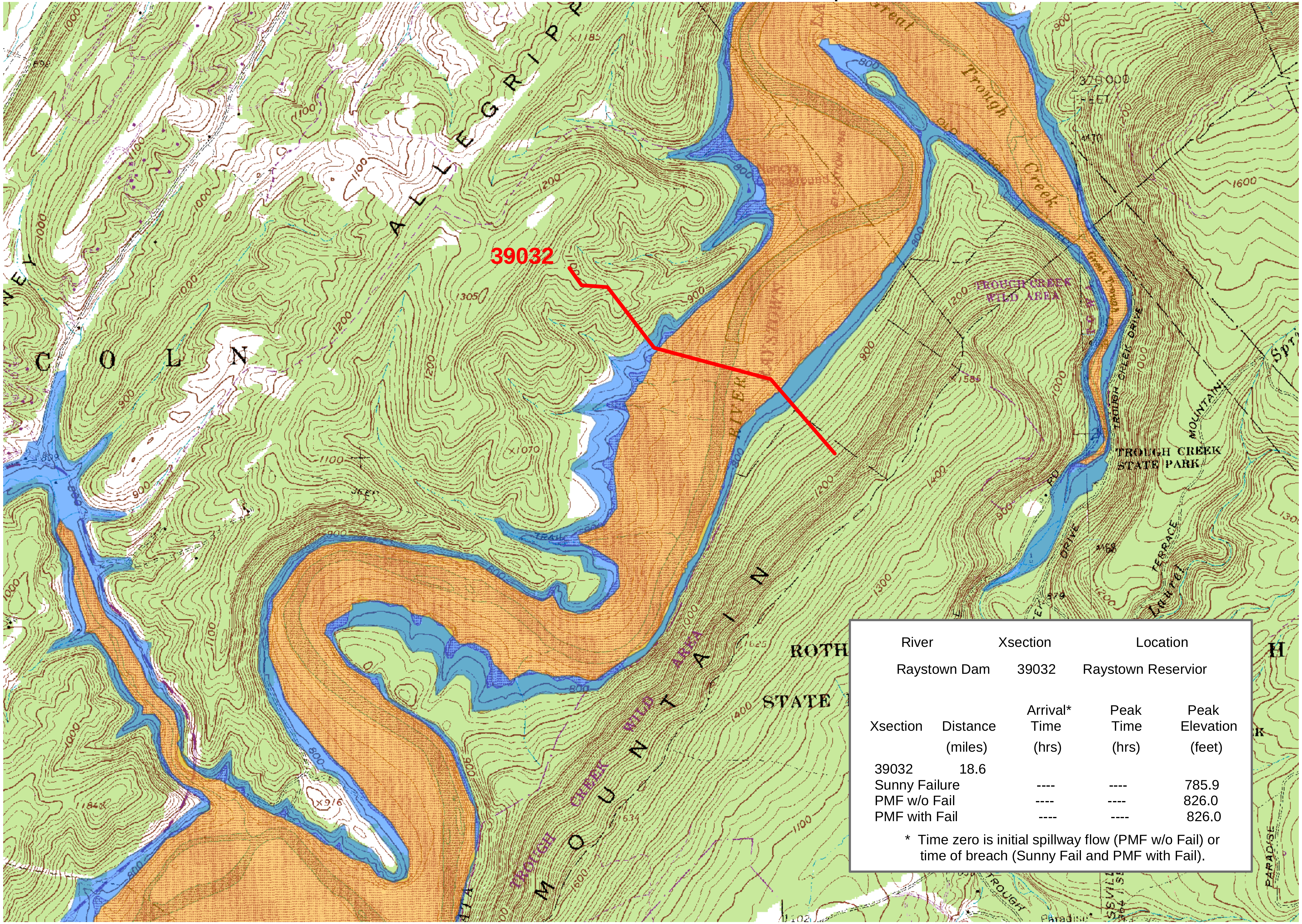


Plate 3

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 5



River	Xsection	Location
Raystown Dam	39032	Raystown Reservior

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
39032	18.6			
Sunny Failure		----	----	785.9
PMF w/o Fail		----	----	826.0
PMF with Fail		----	----	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 3

N

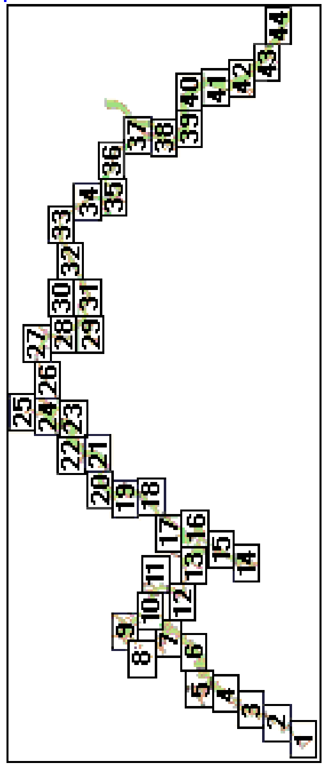
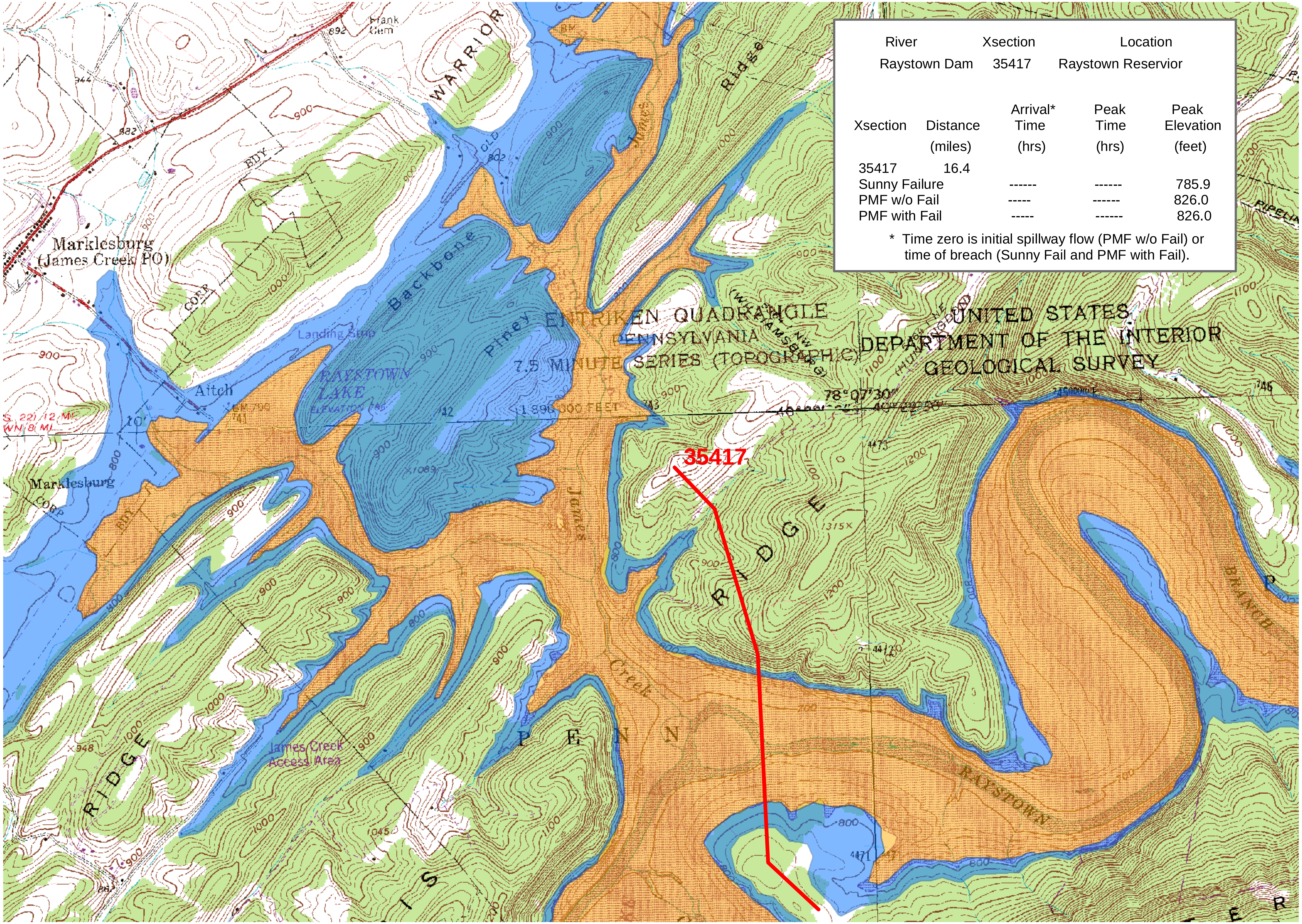


Plate 4

Legend

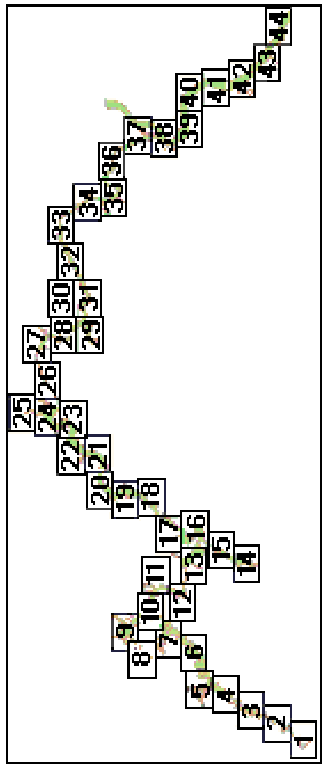
- Sunnyday Failure
- PMF without Failure
- PMF Failure



River	Xsection	Location
Raystown Dam	35417	Raystown Reservior

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
35417	16.4			
Sunny Failure		------	------	785.9
PMF w/o Fail		-----	------	826.0
PMF with Fail		-----	------	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



matches plate 6

N

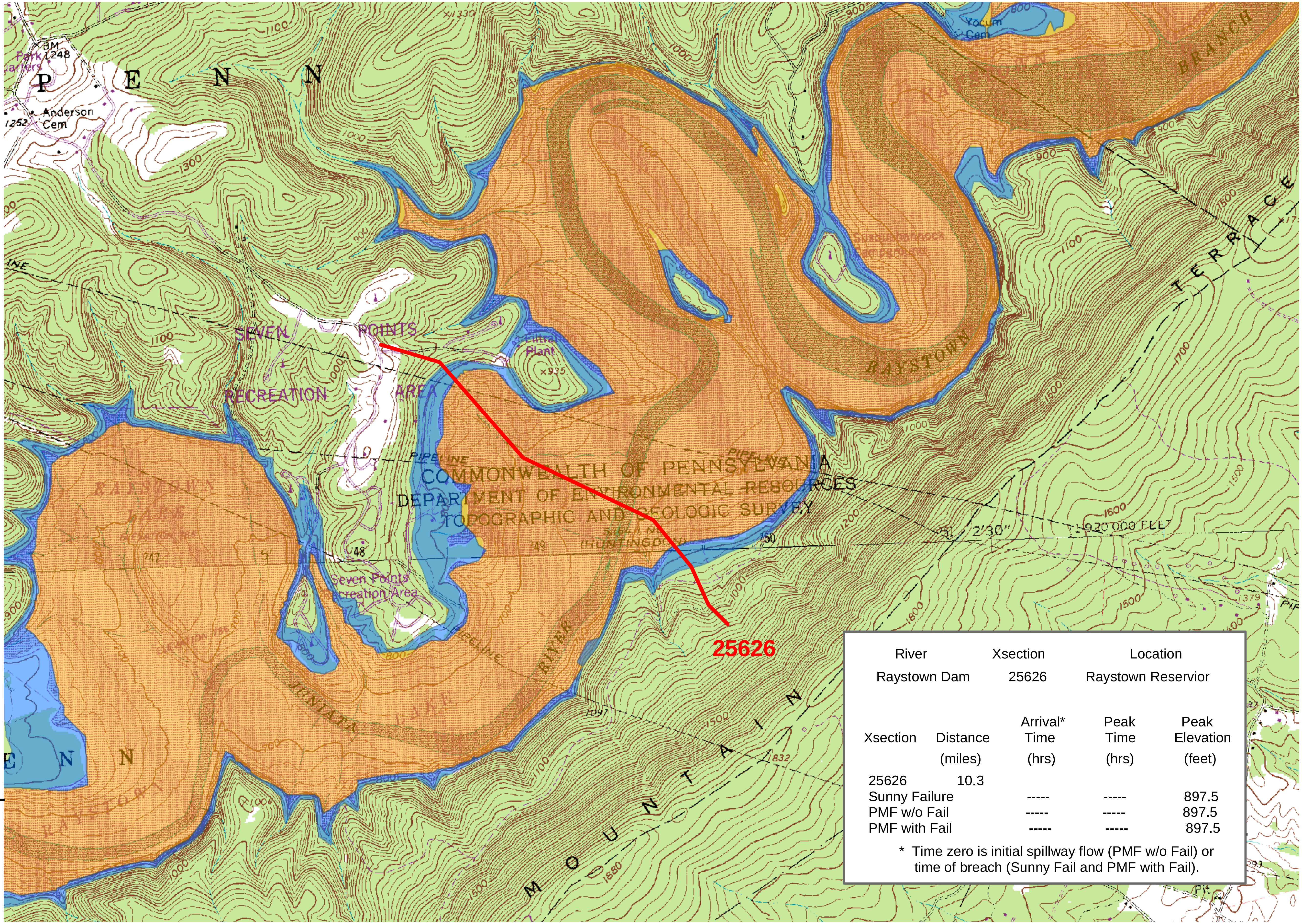
Plate 5

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 4

matches plate 7



River	Xsection	Location
Raystown Dam	25626	Raystown Reservior

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
25626	10.3			
Sunny Failure		-----	-----	897.5
PMF w/o Fail		-----	-----	897.5
PMF with Fail		-----	-----	897.5

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 5

N

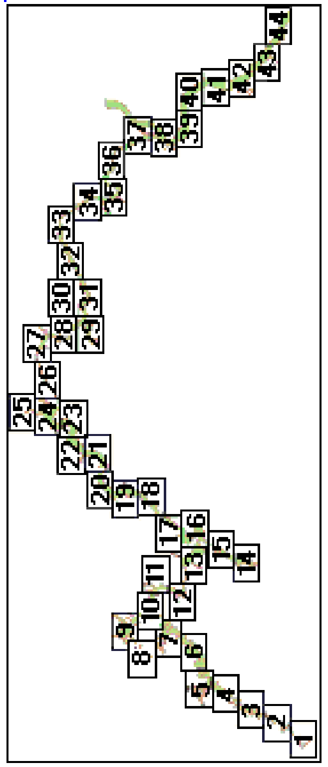
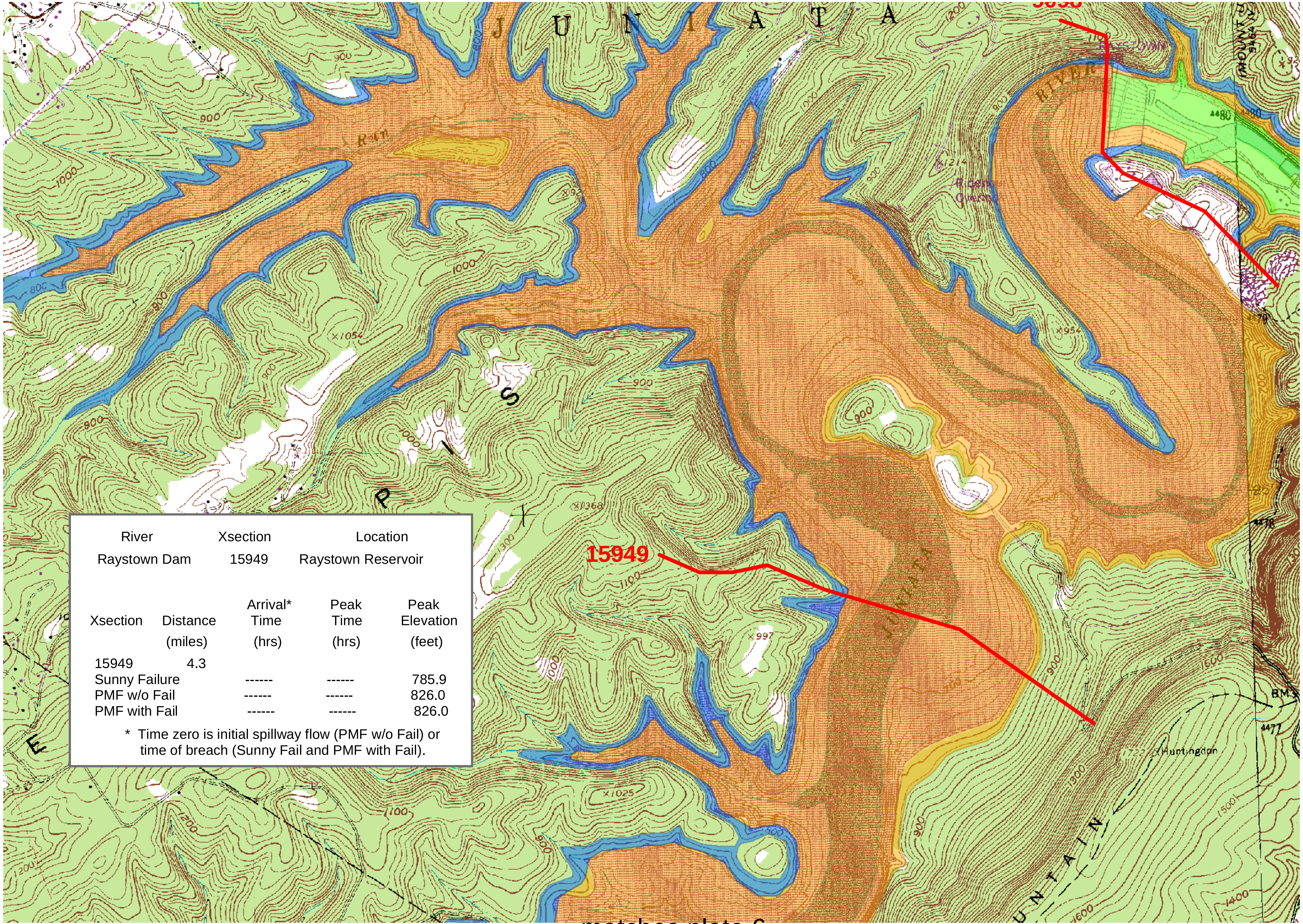


Plate 6

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 10



River	Xsection	Location
Raystown Dam	15949	Raystown Reservoir

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
15949	4.3			
Sunny Failure		------	------	785.9
PMF w/o Fail		------	------	826.0
PMF with Fail		------	------	826.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 6

N

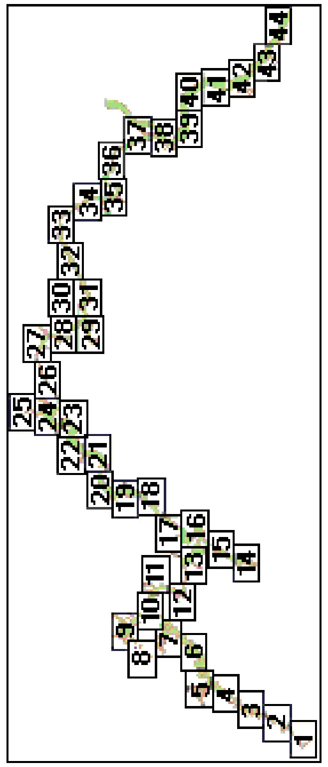


Plate 7

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

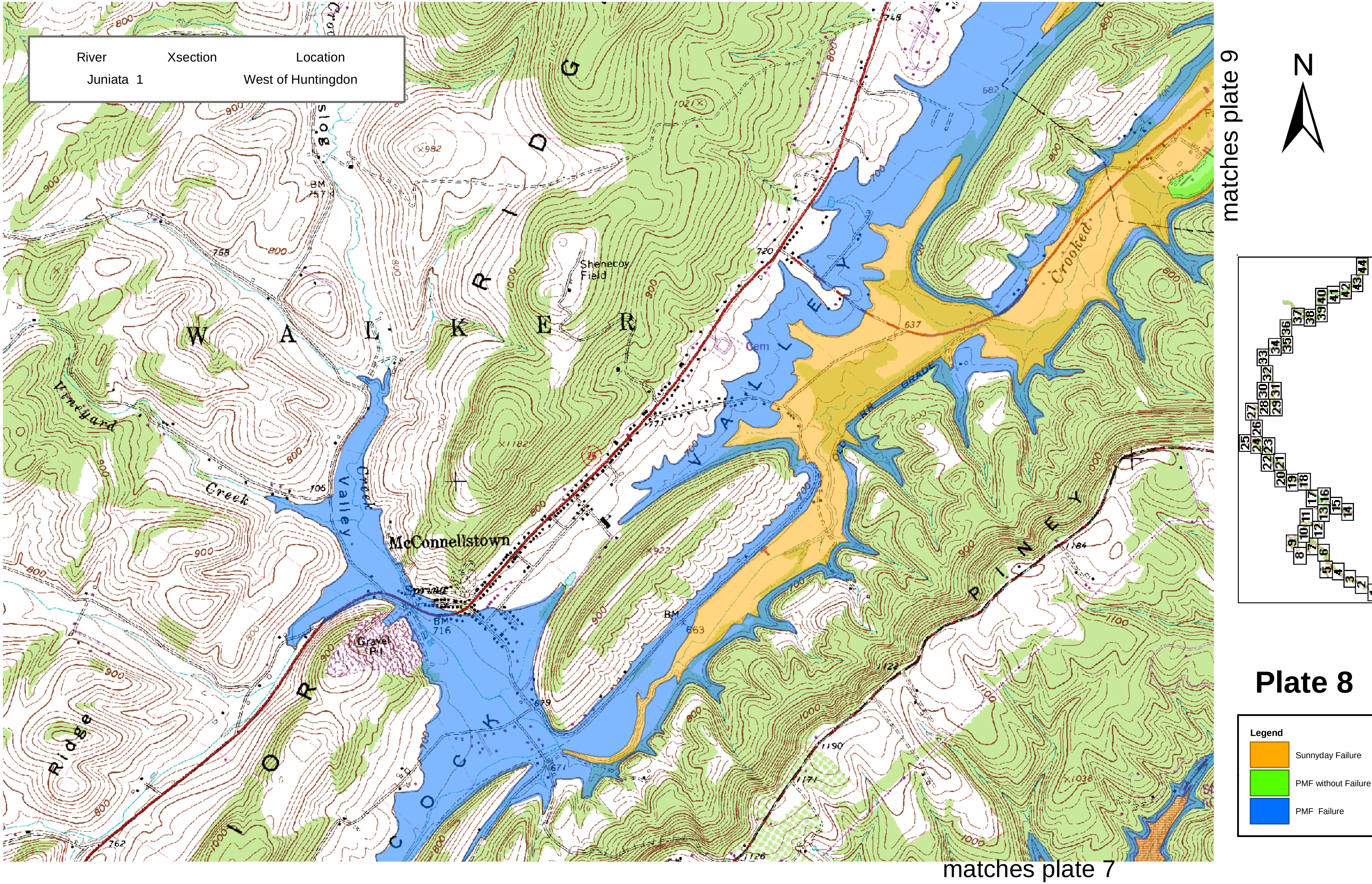
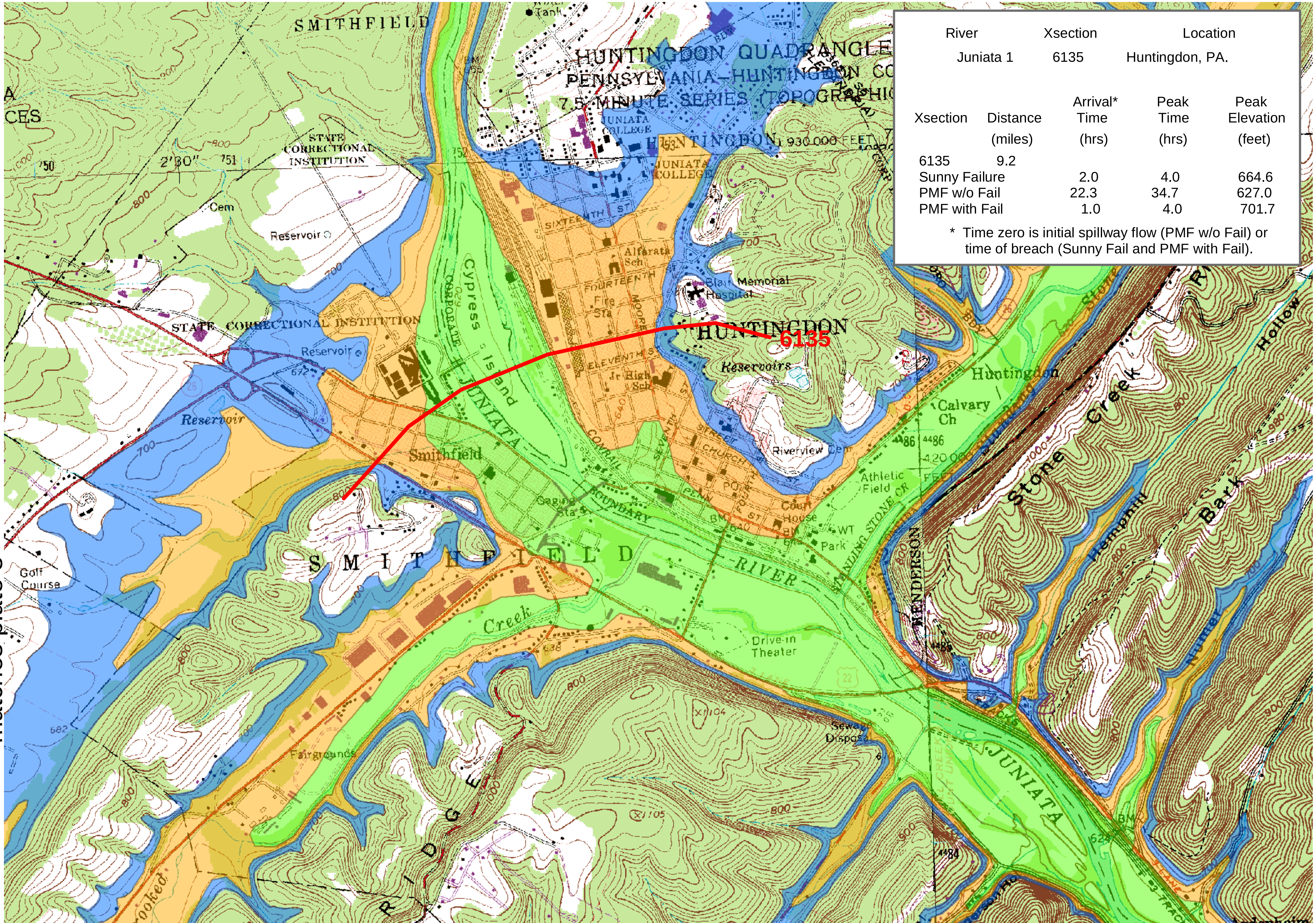

River
Xsection
Location
Juniata 1
West of Huntingdon
W A L K E R R I D G E
McConnellstown
Shenecoy Field
Crooked
V A L L E Y
P I N E Y
Gravel Pit
Creek
Valley
Ridge
Cem
matches plate 9
matches plate 7
N
Legend
Sunnyday Failure
PMF without Failure
PMF Failure

Plate 8



River	Xsection	Location
Juniata 1	6135	Huntingdon, PA.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
6135	9.2			
Sunny Failure		2.0	4.0	664.6
PMF w/o Fail		22.3	34.7	627.0
PMF with Fail		1.0	4.0	701.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

matches plate 8

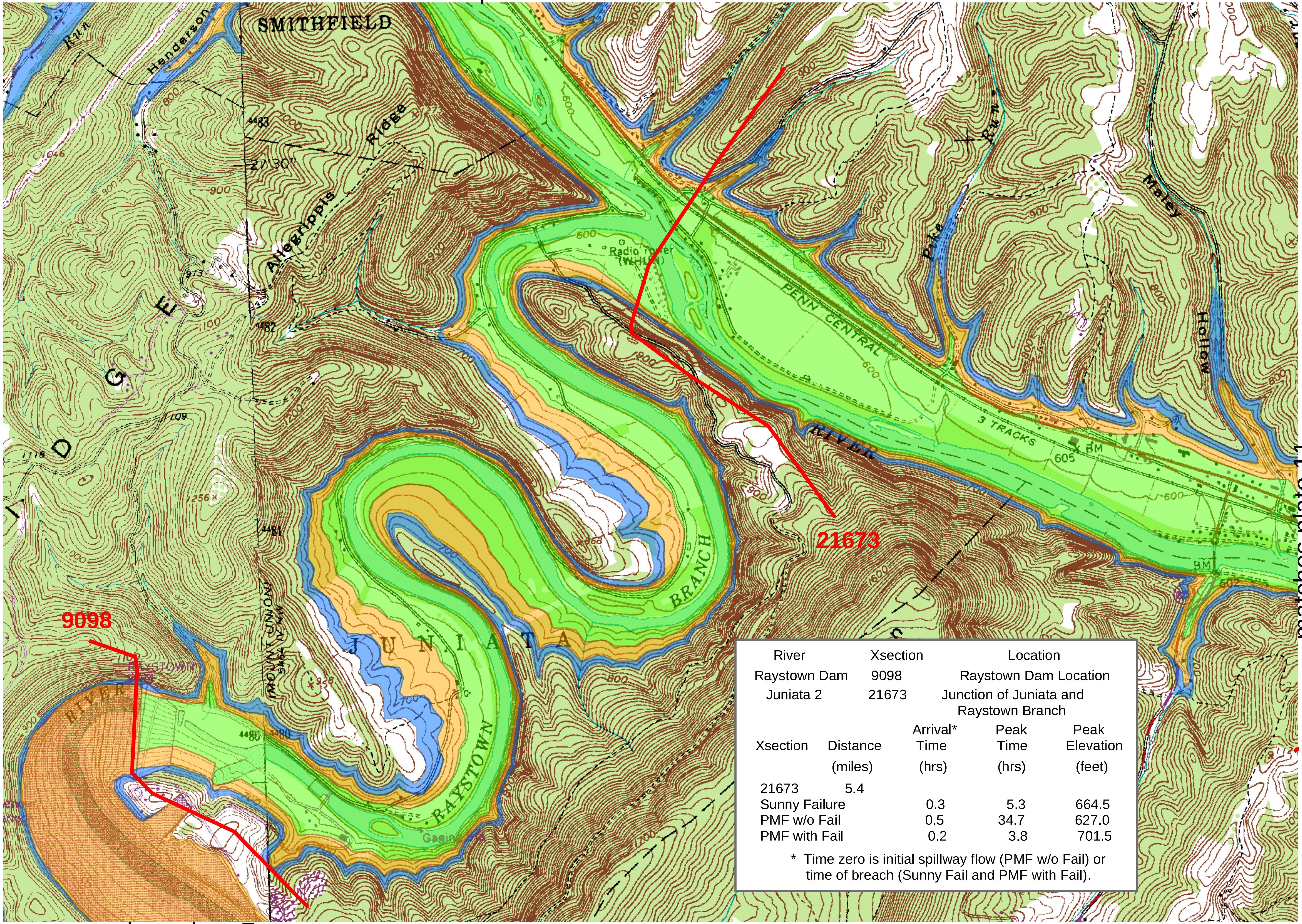
matches plate 10

Plate 9

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 9



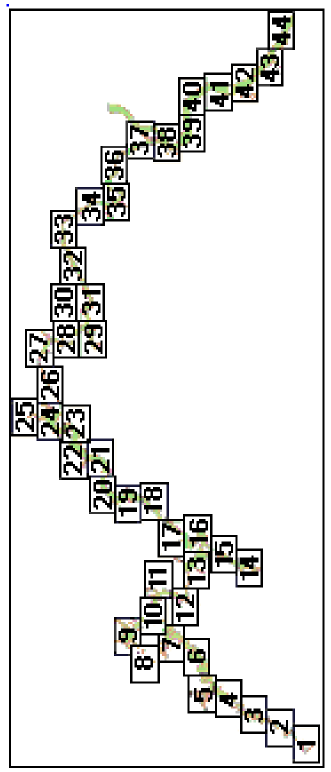
River	Xsection	Location
Raystown Dam	9098	Raystown Dam Location
Juniata 2	21673	Junction of Juniata and Raystown Branch

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
21673	5.4			
Sunny Failure		0.3	5.3	664.5
PMF w/o Fail		0.5	34.7	627.0
PMF with Fail		0.2	3.8	701.5

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 11

matches plate 7



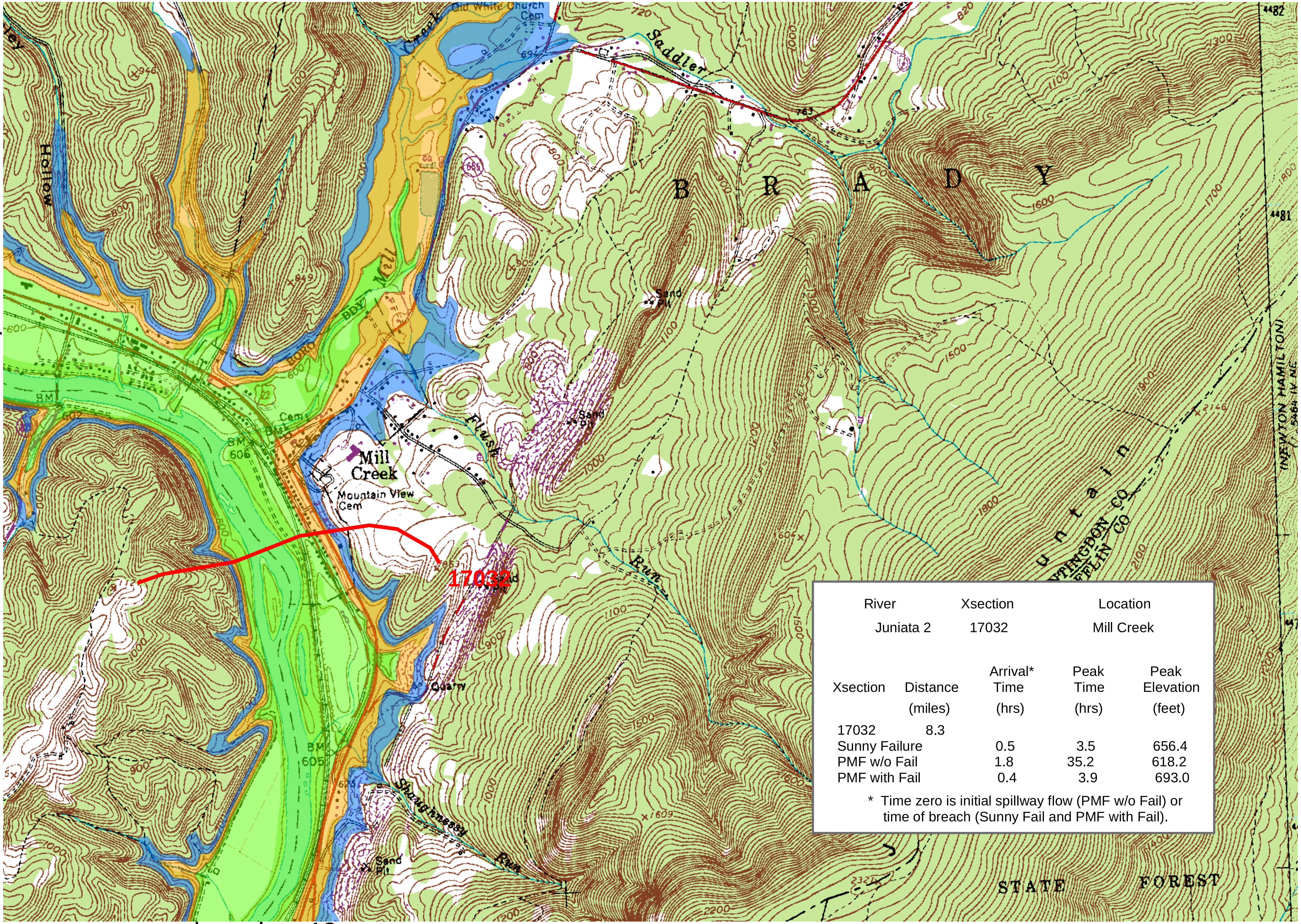
N

Plate 10

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 10



River	Xsection	Location
Juniata 2	17032	Mill Creek

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
17032	8.3			
Sunny Failure		0.5	3.5	656.4
PMF w/o Fail		1.8	35.2	618.2
PMF with Fail		0.4	3.9	693.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 12

N

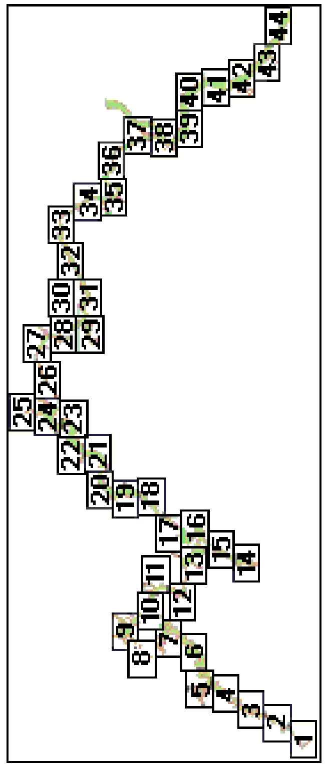
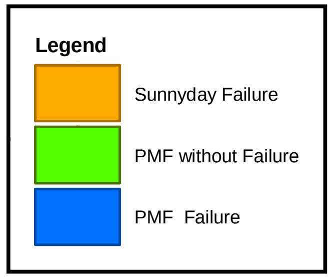
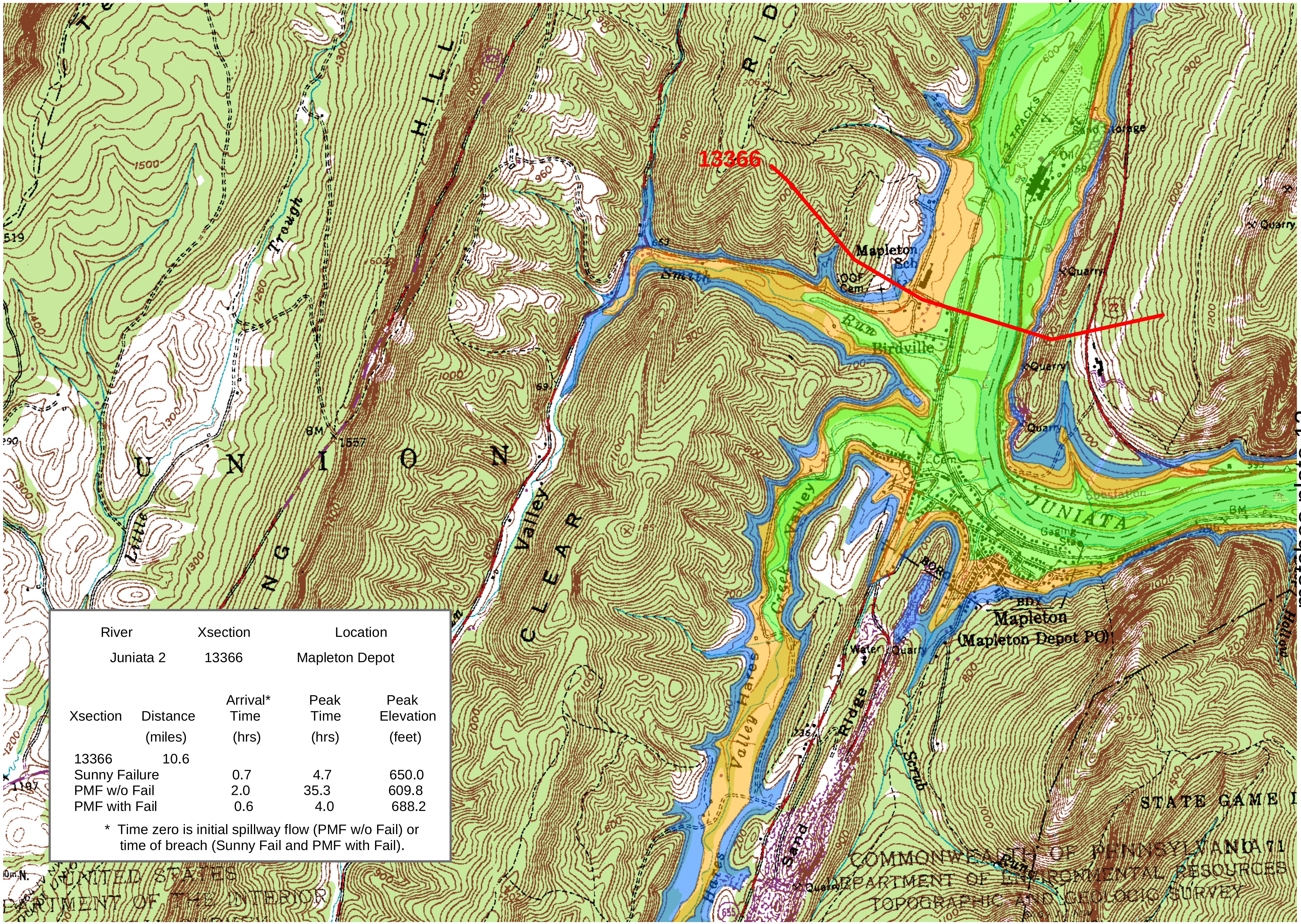


Plate 11



matches plate 11

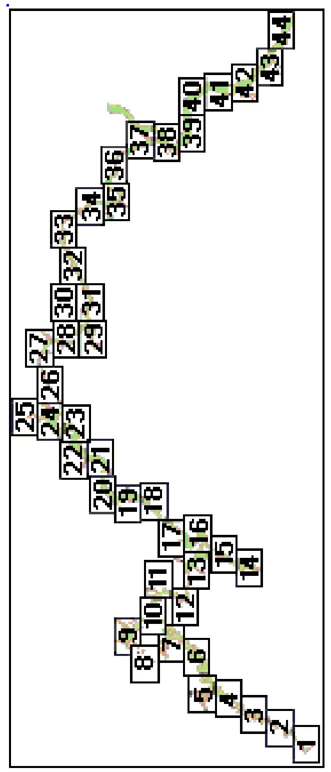


River	Xsection	Location
Juniata 2	13366	Mapleton Depot

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
13366	10.6			
Sunny Failure		0.7	4.7	650.0
PMF w/o Fail		2.0	35.3	609.8
PMF with Fail		0.6	4.0	688.2

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 13



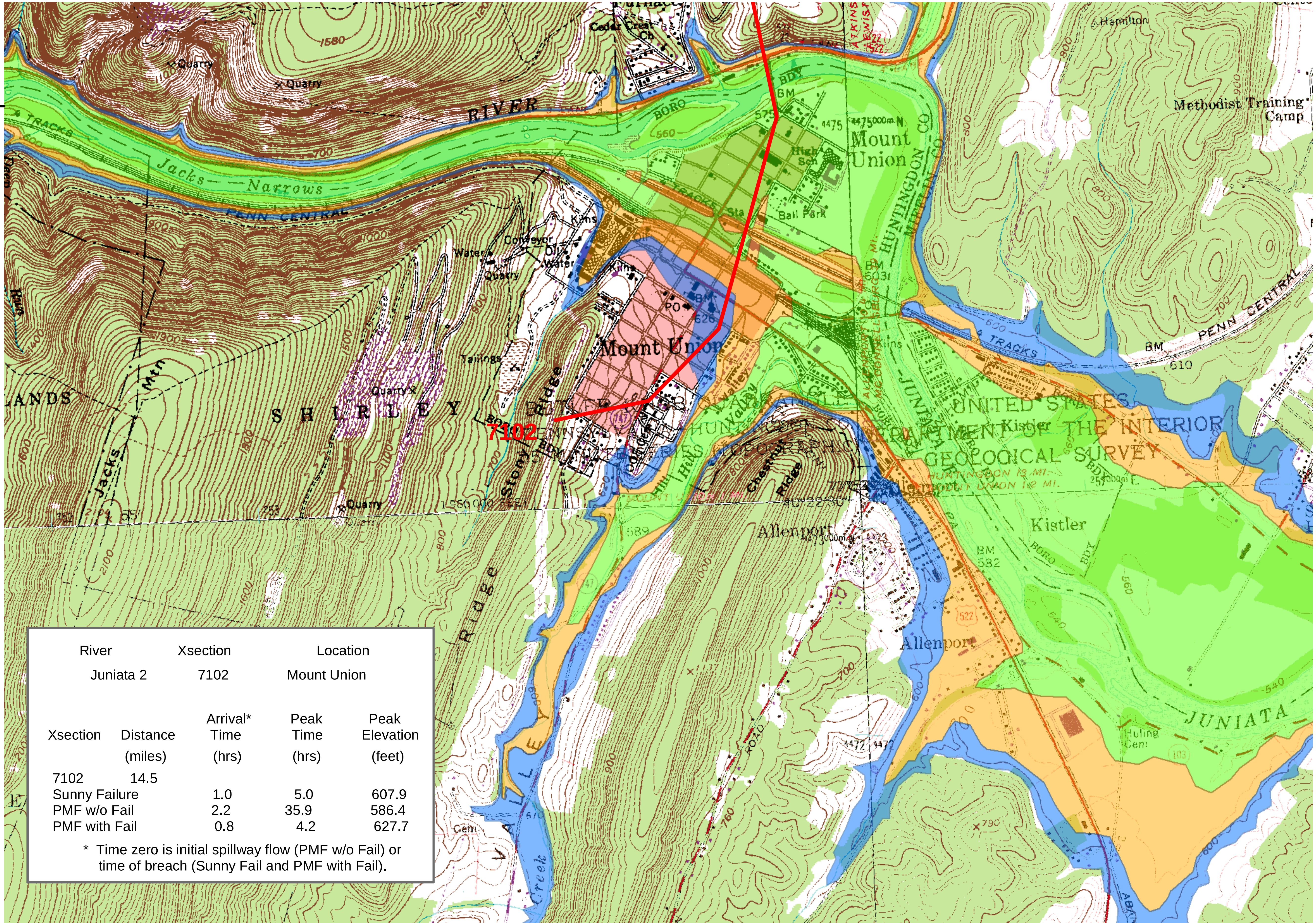
N

Plate 12

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

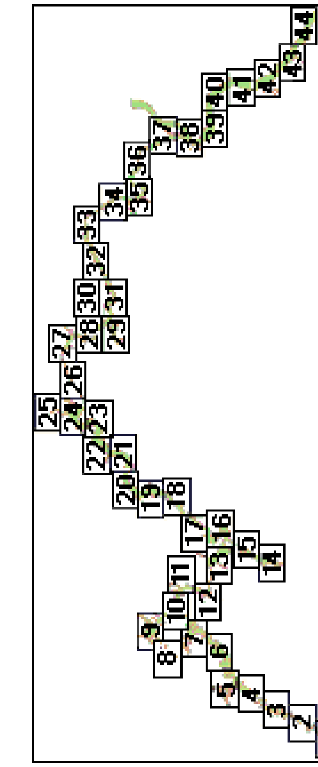
matches plate 12



River	Xsection	Location
Juniata 2	7102	Mount Union

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
7102	14.5			
Sunny Failure		1.0	5.0	607.9
PMF w/o Fail		2.2	35.9	586.4
PMF with Fail		0.8	4.2	627.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



N

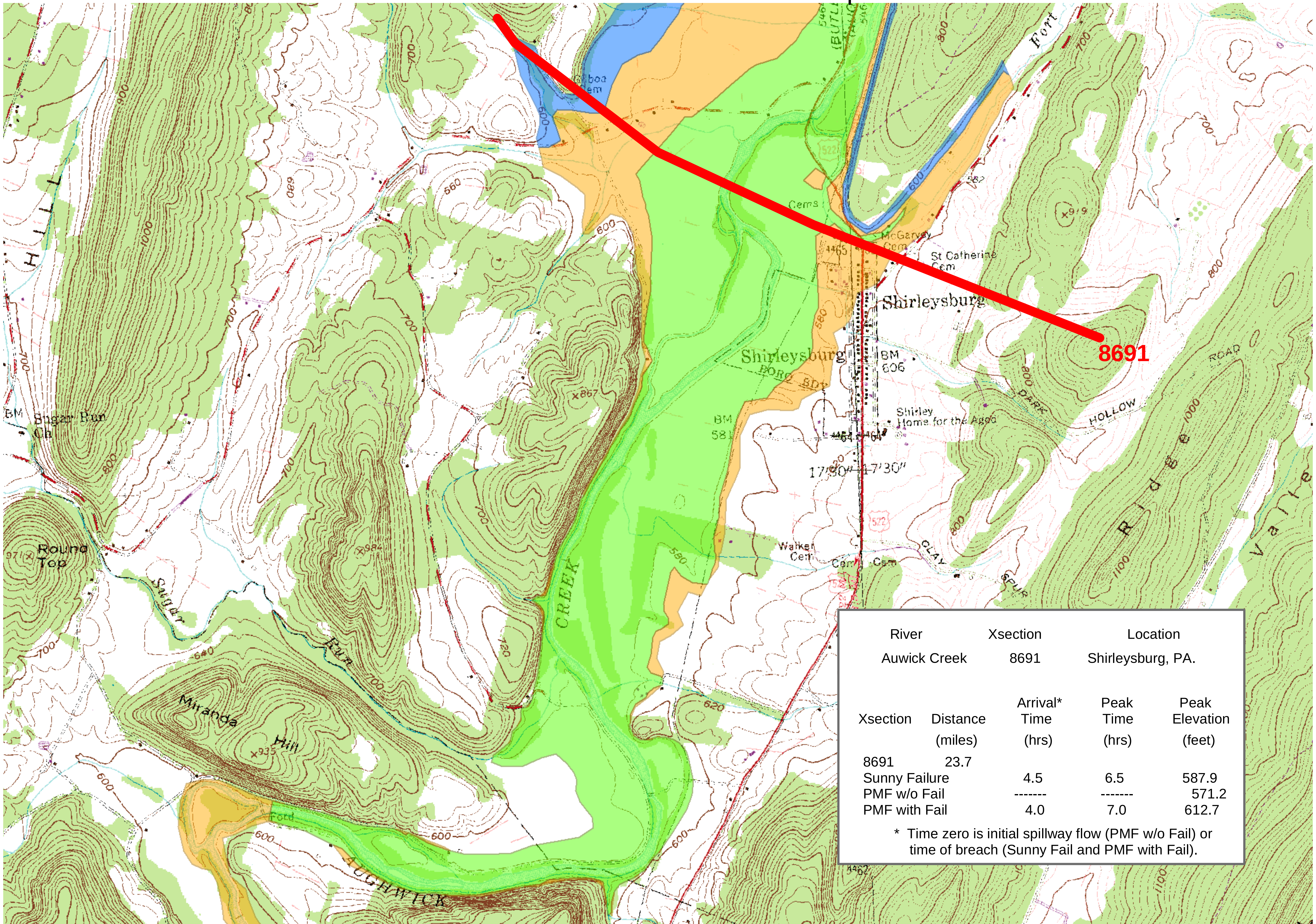
matches plate 16

Plate 13

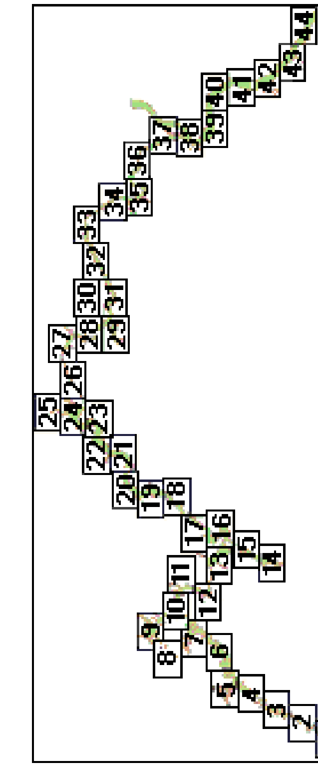
Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 15



end of study



N

River	Xsection	Location
Auwick Creek	8691	Shirleysburg, PA.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
8691	23.7			
Sunny Failure		4.5	6.5	587.9
PMF w/o Fail		-------	-------	571.2
PMF with Fail		4.0	7.0	612.7

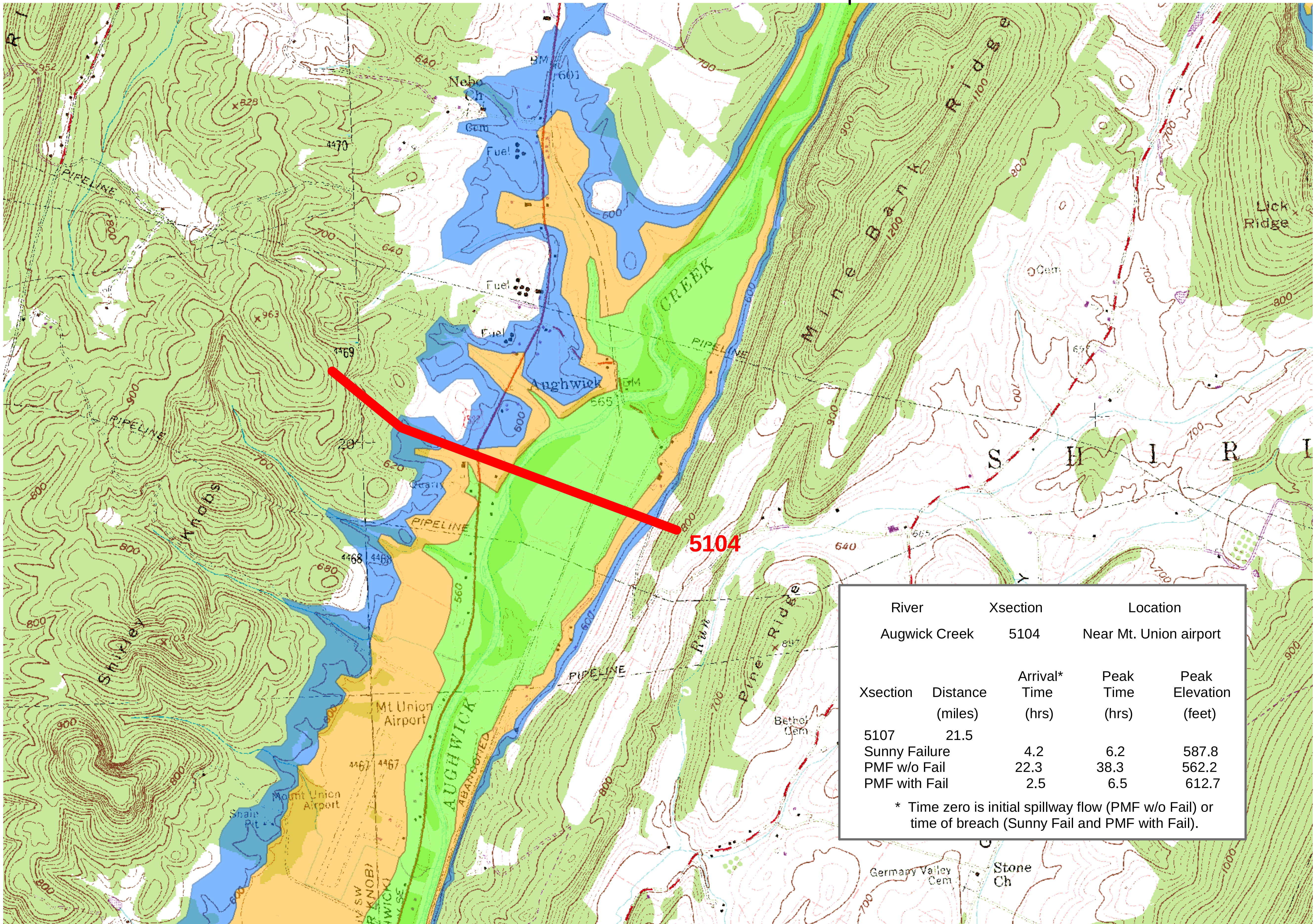
* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

Plate 14

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 16

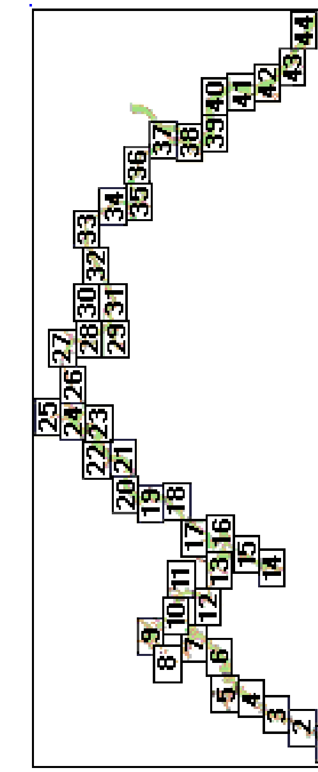


River	Xsection	Location
Augwick Creek	5104	Near Mt. Union airport

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
5107	21.5			
Sunny Failure		4.2	6.2	587.8
PMF w/o Fail		22.3	38.3	562.2
PMF with Fail		2.5	6.5	612.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 14



N

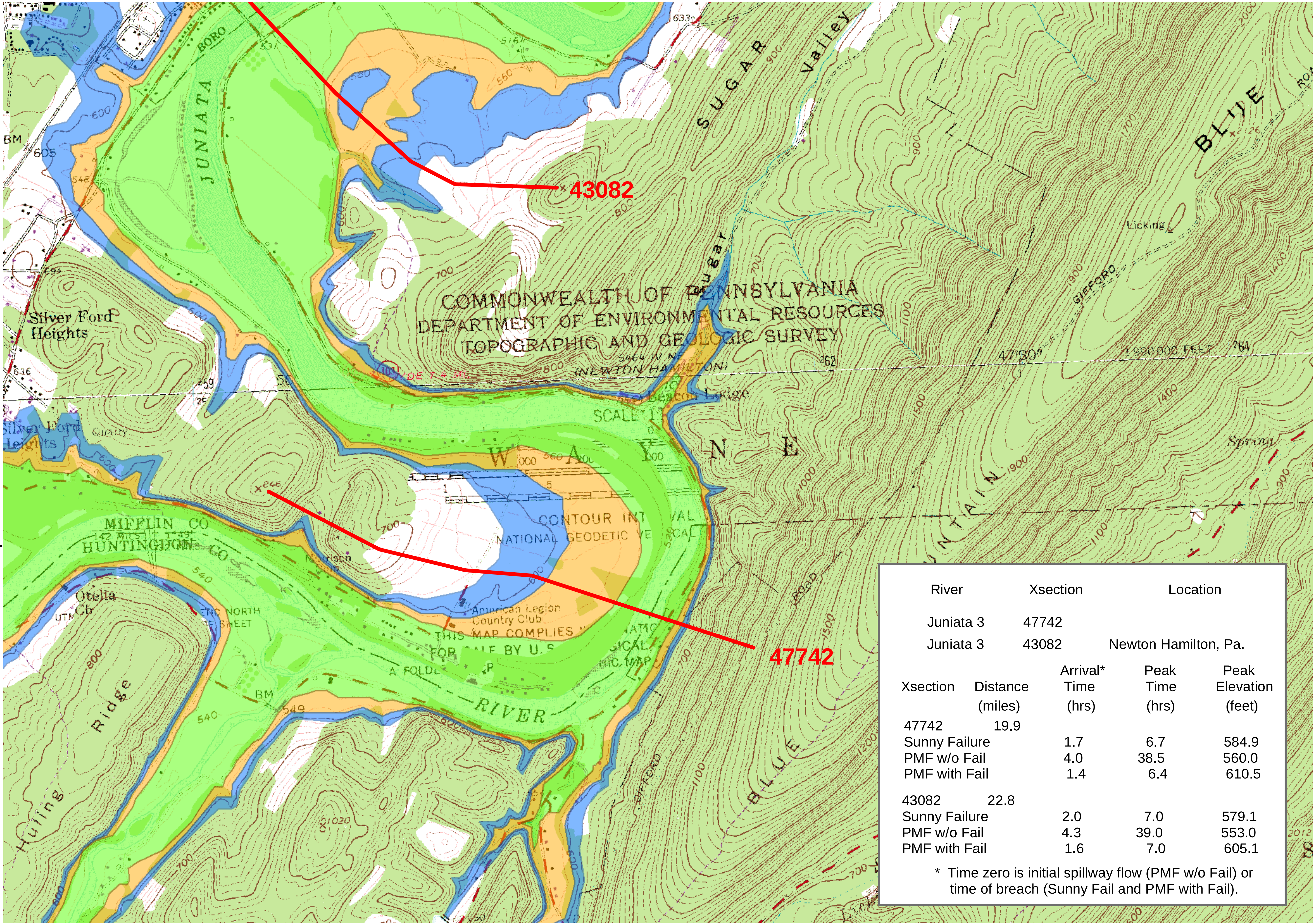
Plate 15

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 17

matches plate 13



matches plate 15

River	Xsection	Location
Juniata 3	47742	
Juniata 3	43082	Newton Hamilton, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
47742	19.9			
Sunny Failure		1.7	6.7	584.9
PMF w/o Fail		4.0	38.5	560.0
PMF with Fail		1.4	6.4	610.5
43082	22.8			
Sunny Failure		2.0	7.0	579.1
PMF w/o Fail		4.3	39.0	553.0
PMF with Fail		1.6	7.0	605.1

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

Plate 16

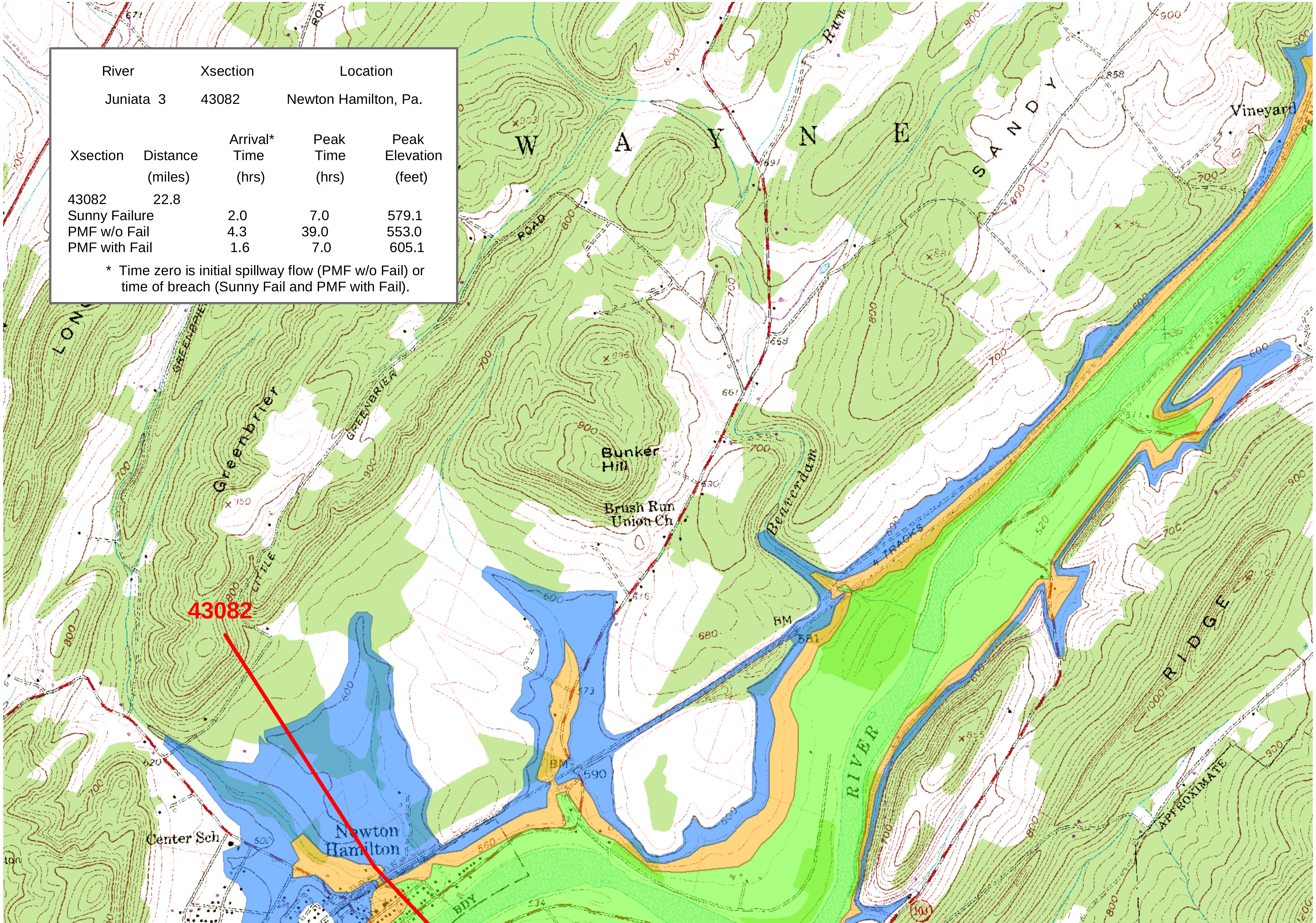
Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

River	Xsection	Location
Juniata 3	43082	Newton Hamilton, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
43082	22.8			
Sunny Failure		2.0	7.0	579.1
PMF w/o Fail		4.3	39.0	553.0
PMF with Fail		1.6	7.0	605.1

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



matches plate 16

matches plate 18

N

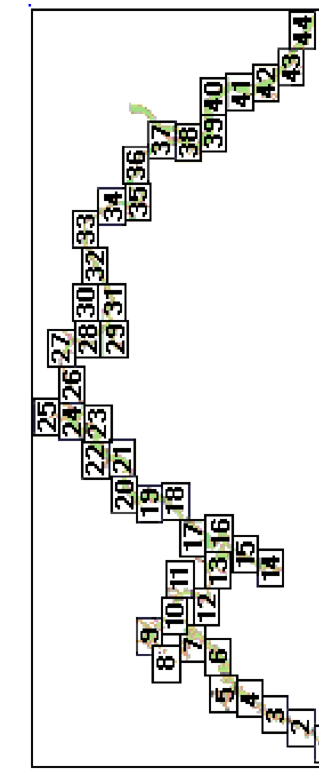
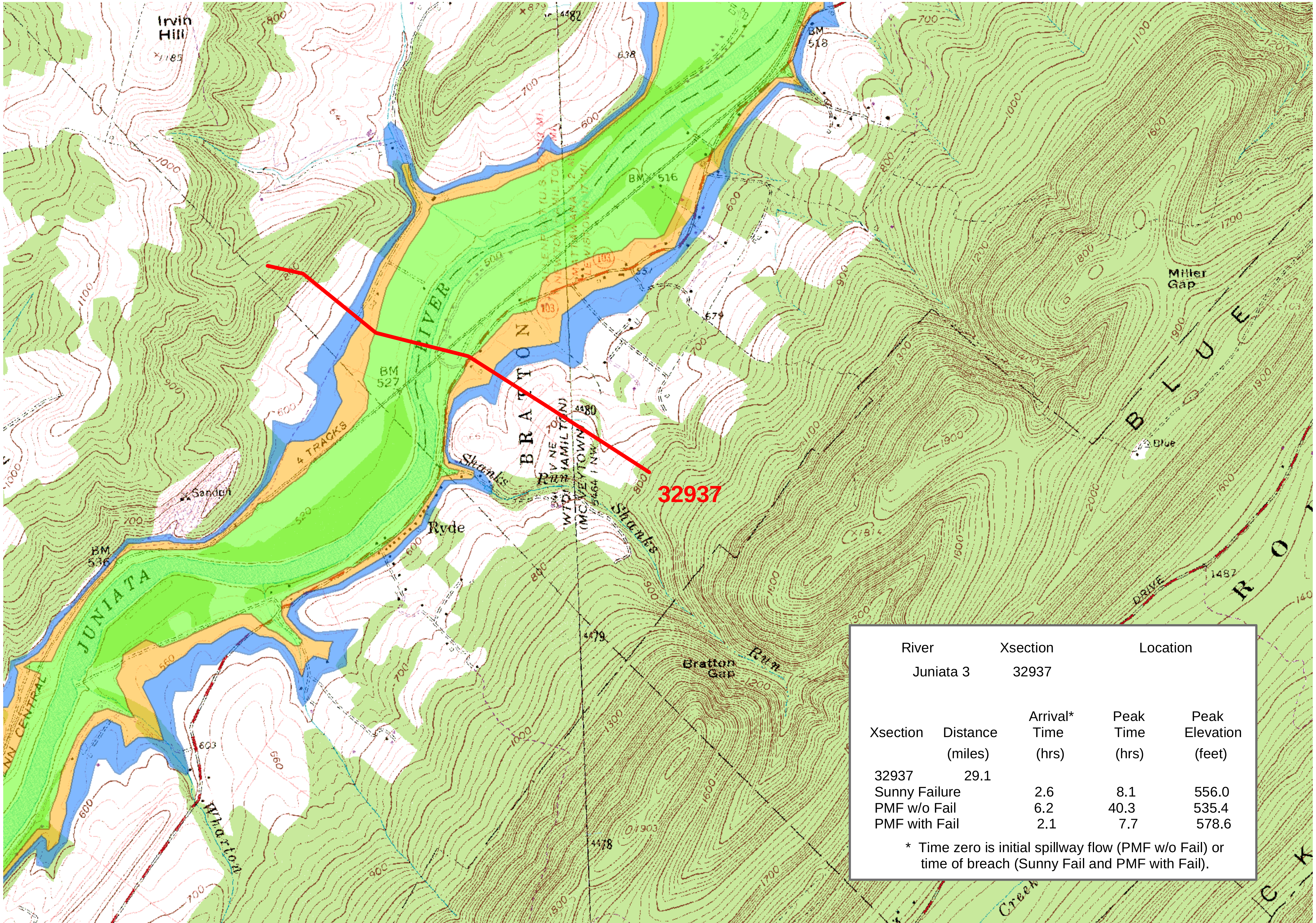


Plate 17

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 19



River	Xsection	Location
Juniata 3	32937	

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
32937	29.1			
Sunny Failure		2.6	8.1	556.0
PMF w/o Fail		6.2	40.3	535.4
PMF with Fail		2.1	7.7	578.6

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

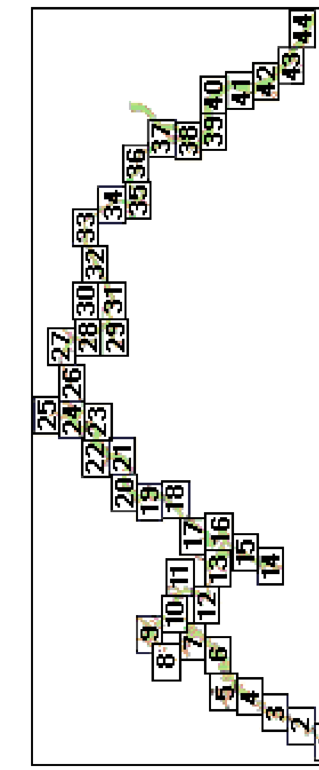


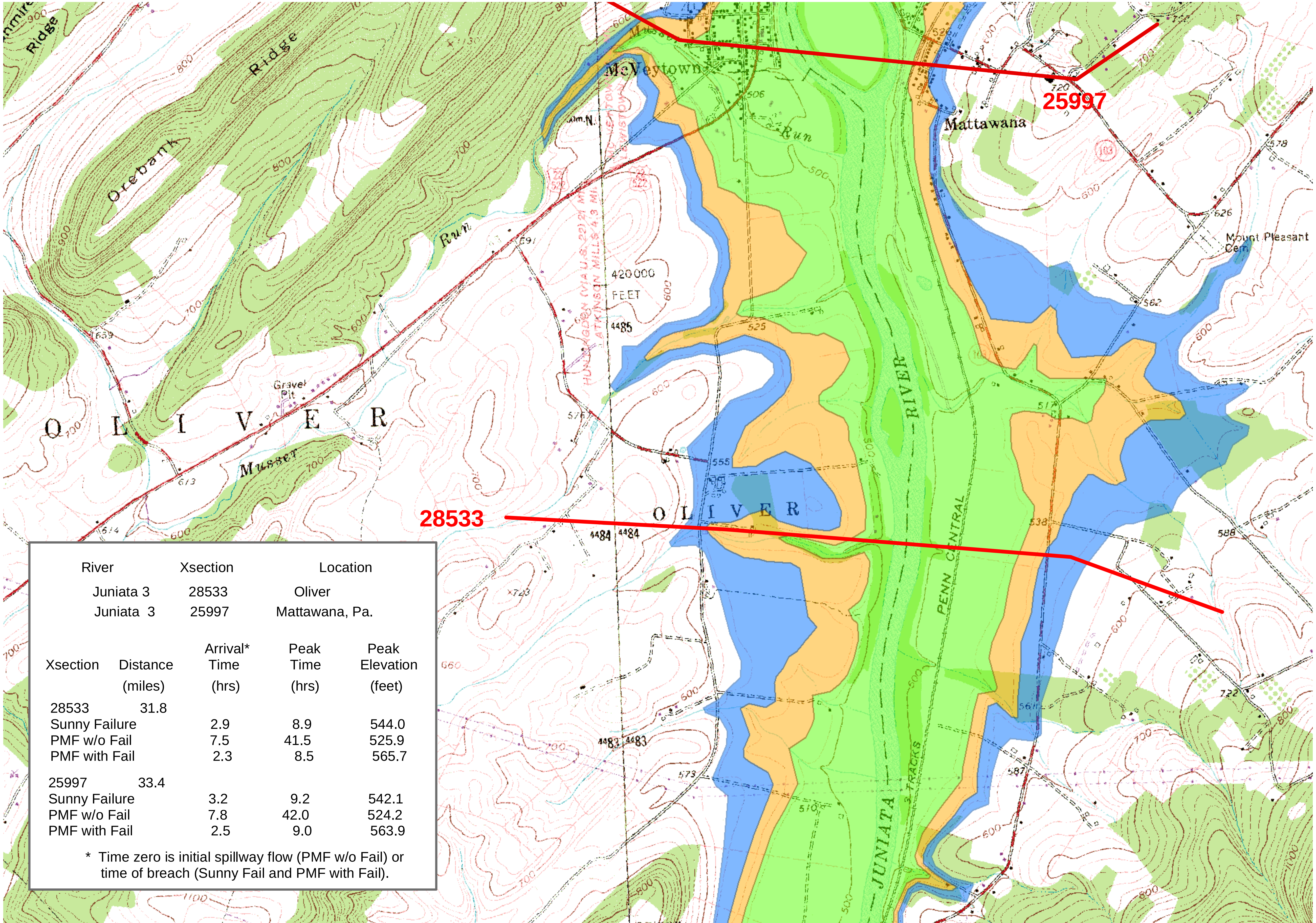
Plate 18

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 17

matches plate 20



River	Xsection	Location
Juniata 3	28533	Oliver
Juniata 3	25997	Mattawana, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
28533	31.8			
Sunny Failure		2.9	8.9	544.0
PMF w/o Fail		7.5	41.5	525.9
PMF with Fail		2.3	8.5	565.7
25997	33.4			
Sunny Failure		3.2	9.2	542.1
PMF w/o Fail		7.8	42.0	524.2
PMF with Fail		2.5	9.0	563.9

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 18

N

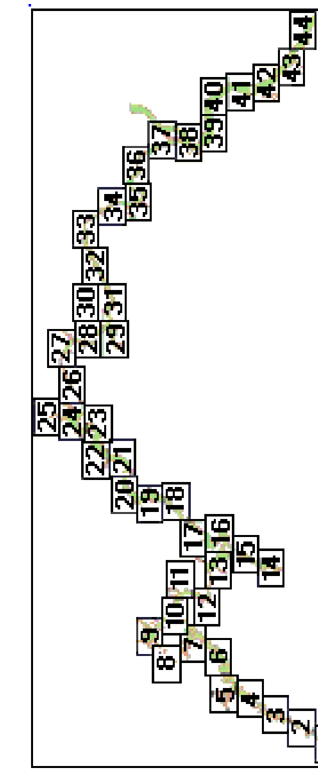


Plate 19

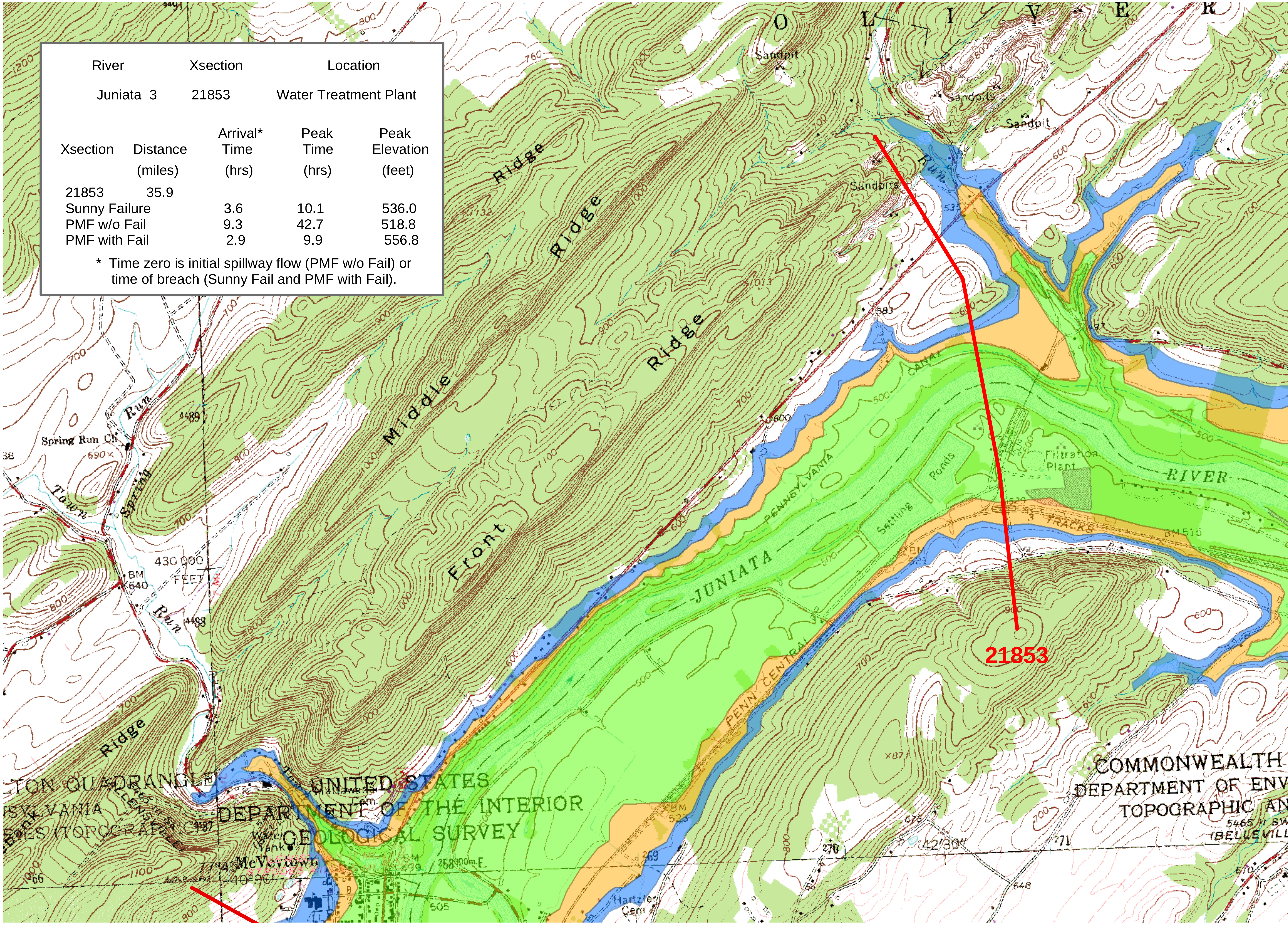
Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

River	Xsection	Location
Juniata 3	21853	Water Treatment Plant

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
21853	35.9			
Sunny Failure		3.6	10.1	536.0
PMF w/o Fail		9.3	42.7	518.8
PMF with Fail		2.9	9.9	556.8

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



matches plate 21

matches plate 19

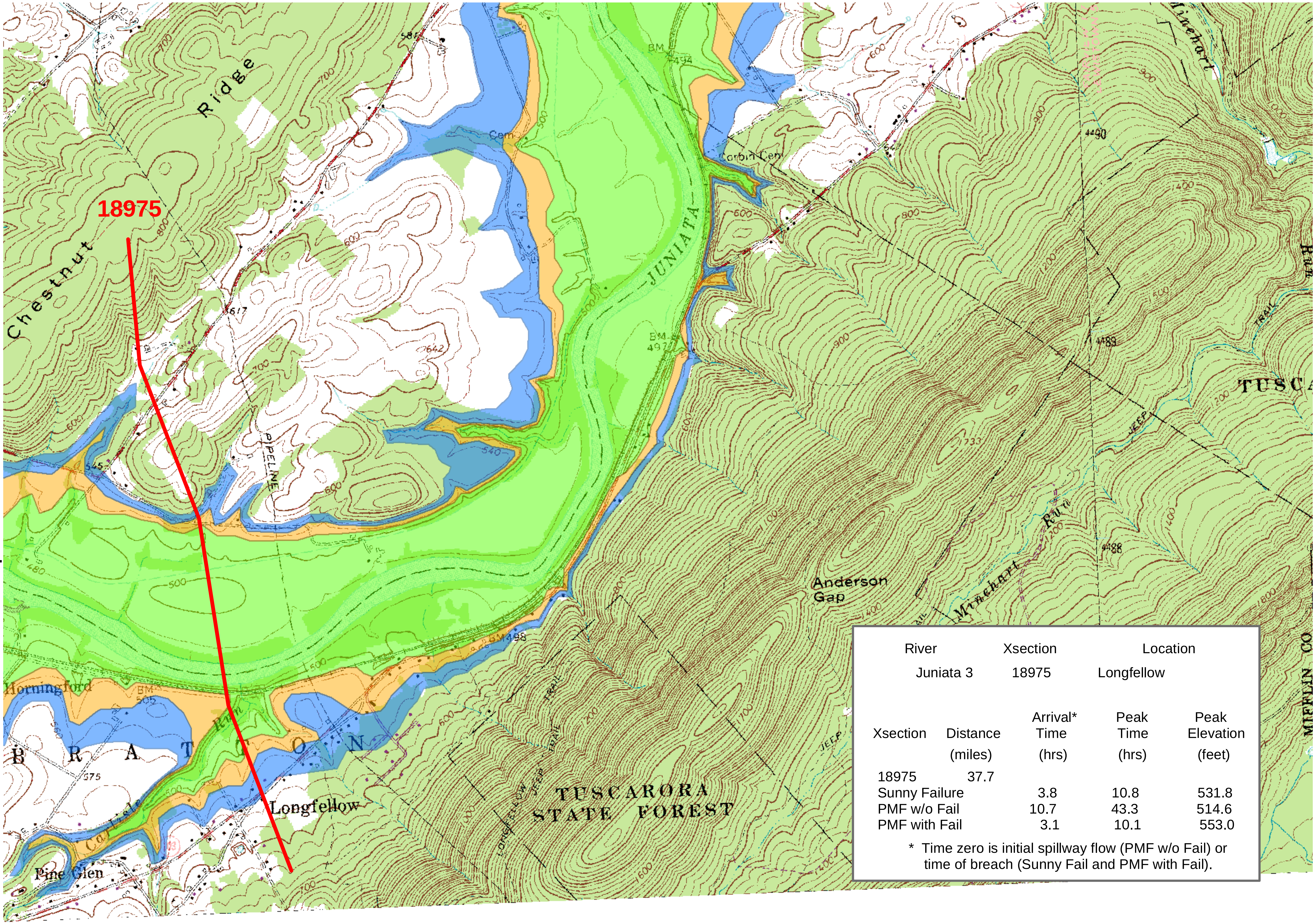
N

Plate 20

Legend
- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 22

matches plate 20



River	Xsection	Location
Juniata 3	18975	Longfellow

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
18975	37.7			
Sunny Failure		3.8	10.8	531.8
PMF w/o Fail		10.7	43.3	514.6
PMF with Fail		3.1	10.1	553.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

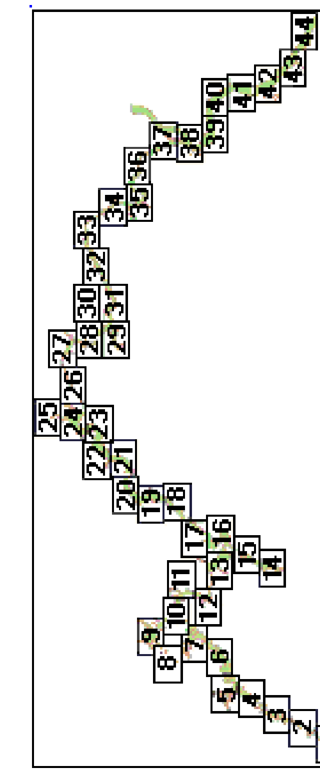


Plate 21

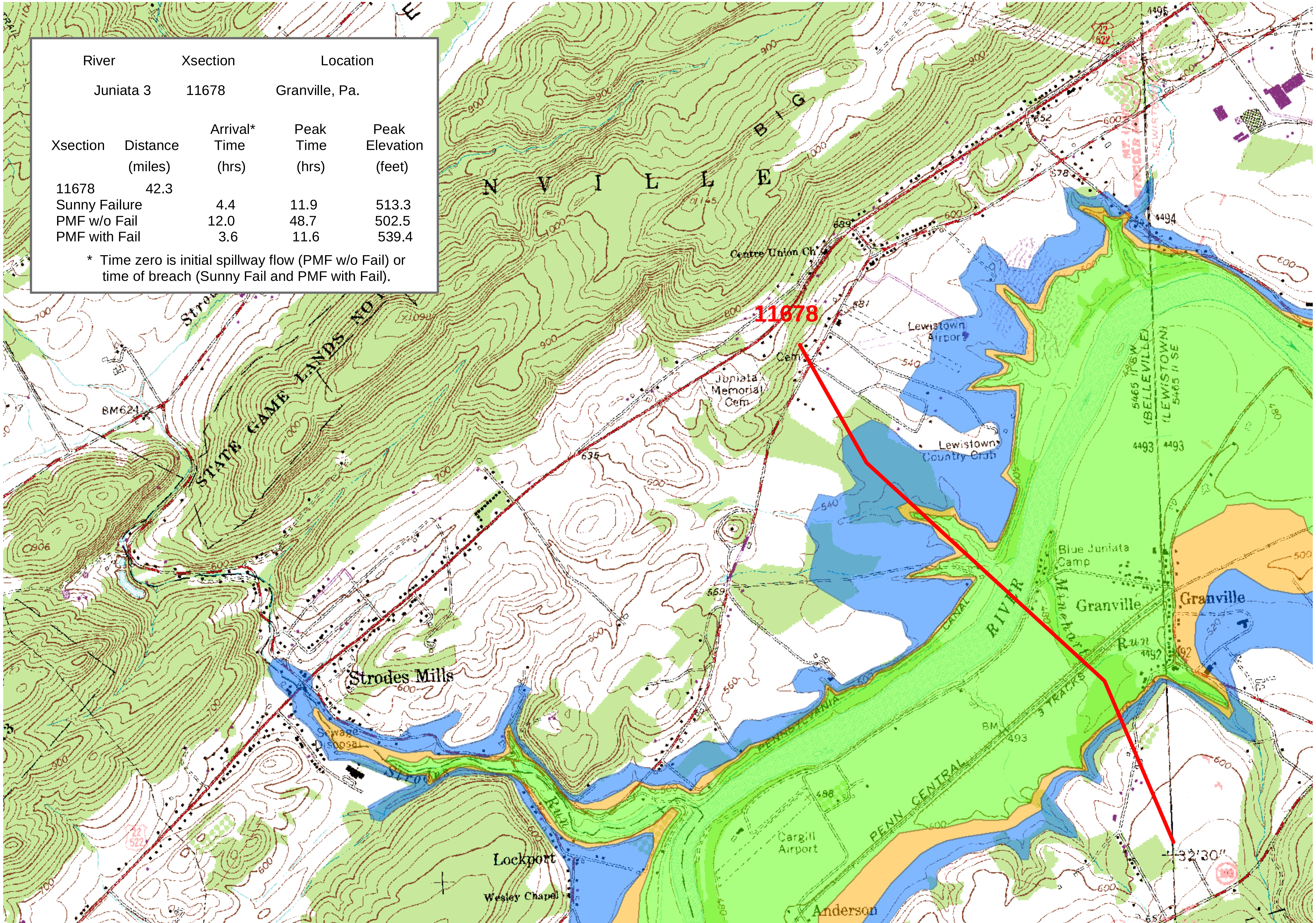
Legend

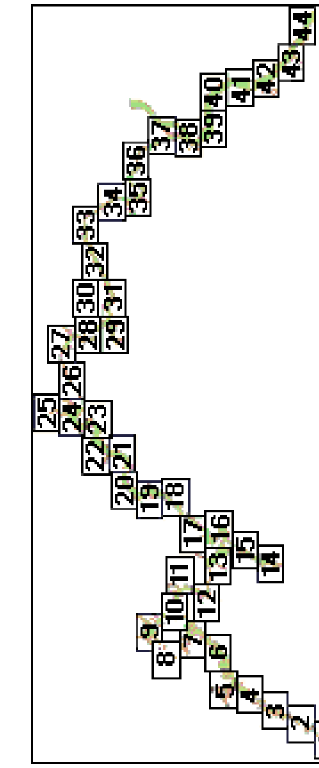
- Sunnyday Failure
- PMF without Failure
- PMF Failure

River	Xsection	Location
Juniata 3	11678	Granville, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
11678	42.3			
Sunny Failure		4.4	11.9	513.3
PMF w/o Fail		12.0	48.7	502.5
PMF with Fail		3.6	11.6	539.4

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



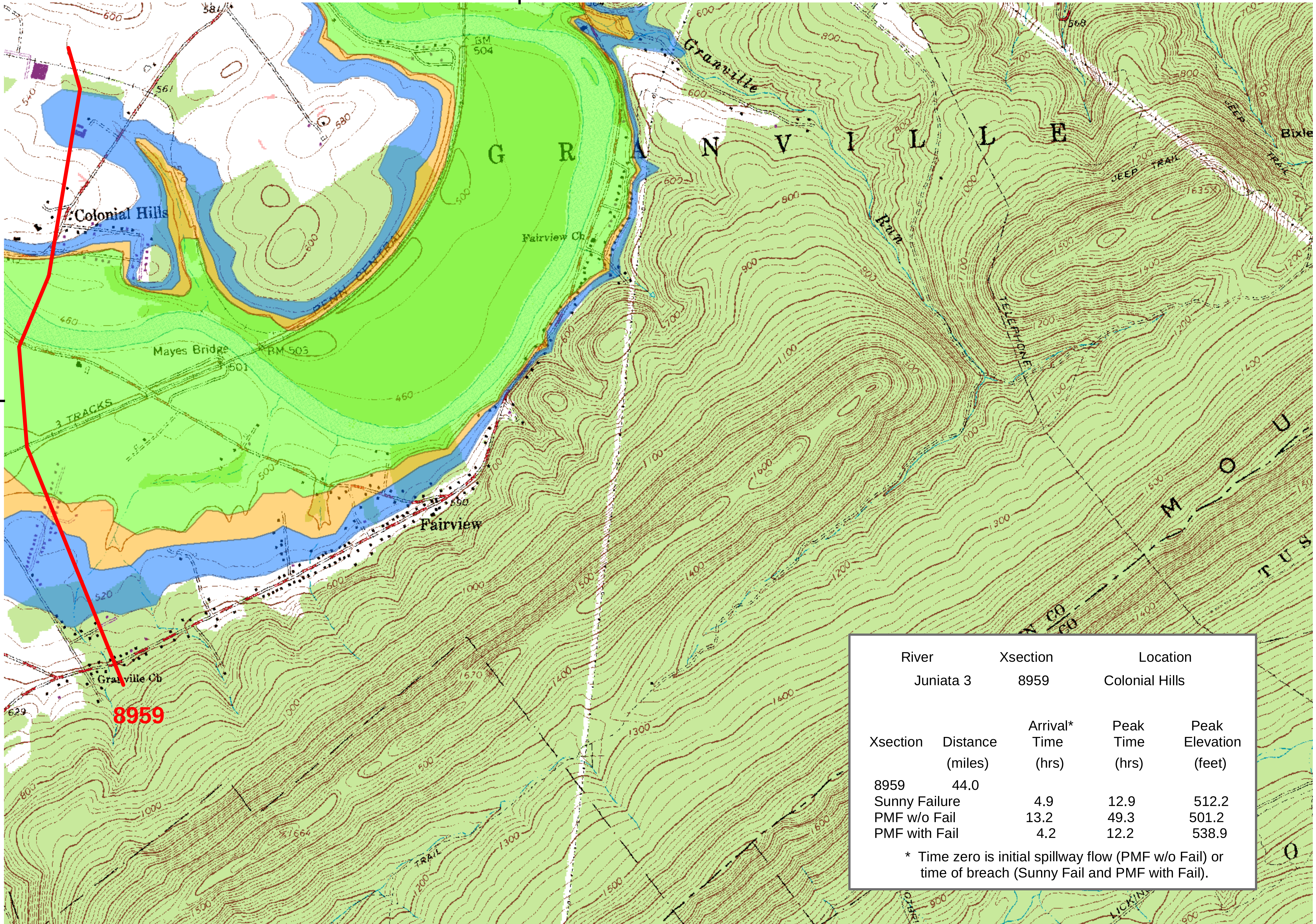


matches plate 21

Plate 22

matches plate 24

matches plate 22



River	Xsection	Location
Juniata 3	8959	Colonial Hills

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
8959	44.0			
Sunny Failure		4.9	12.9	512.2
PMF w/o Fail		13.2	49.3	501.2
PMF with Fail		4.2	12.2	538.9

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

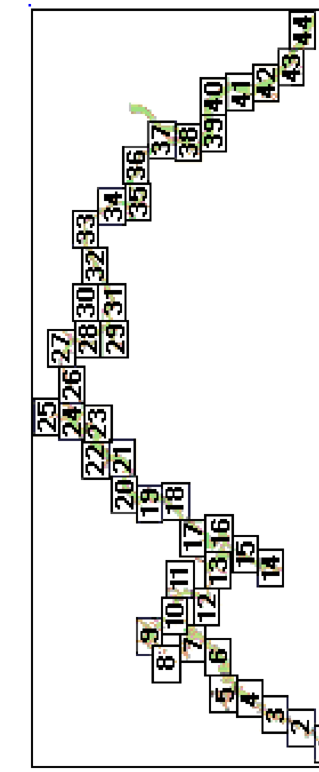


Plate 23

Legend

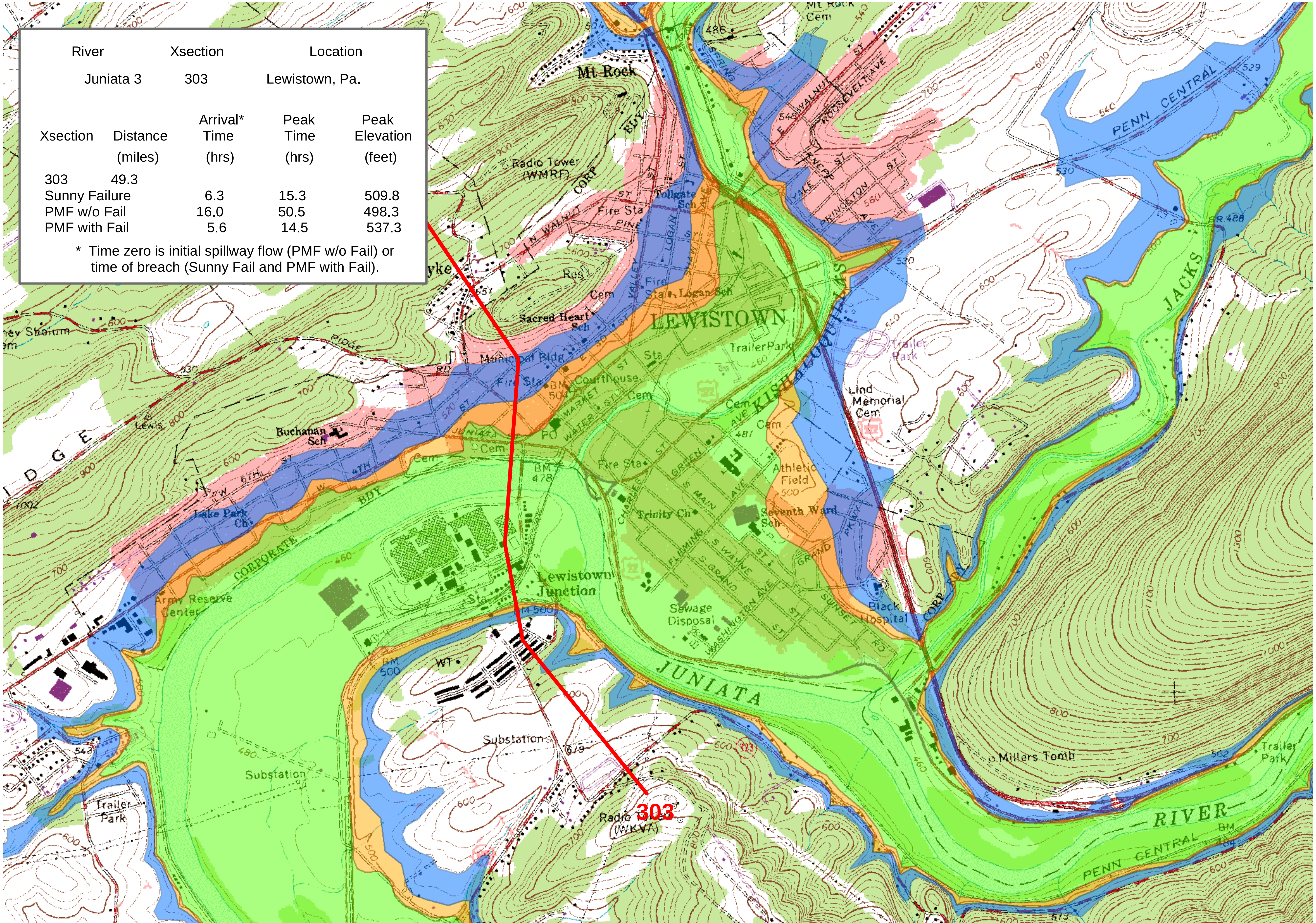
- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 25

River	Xsection	Location
Juniata 3	303	Lewistown, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
303	49.3			
Sunny Failure		6.3	15.3	509.8
PMF w/o Fail		16.0	50.5	498.3
PMF with Fail		5.6	14.5	537.3

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



matches plate 26

N

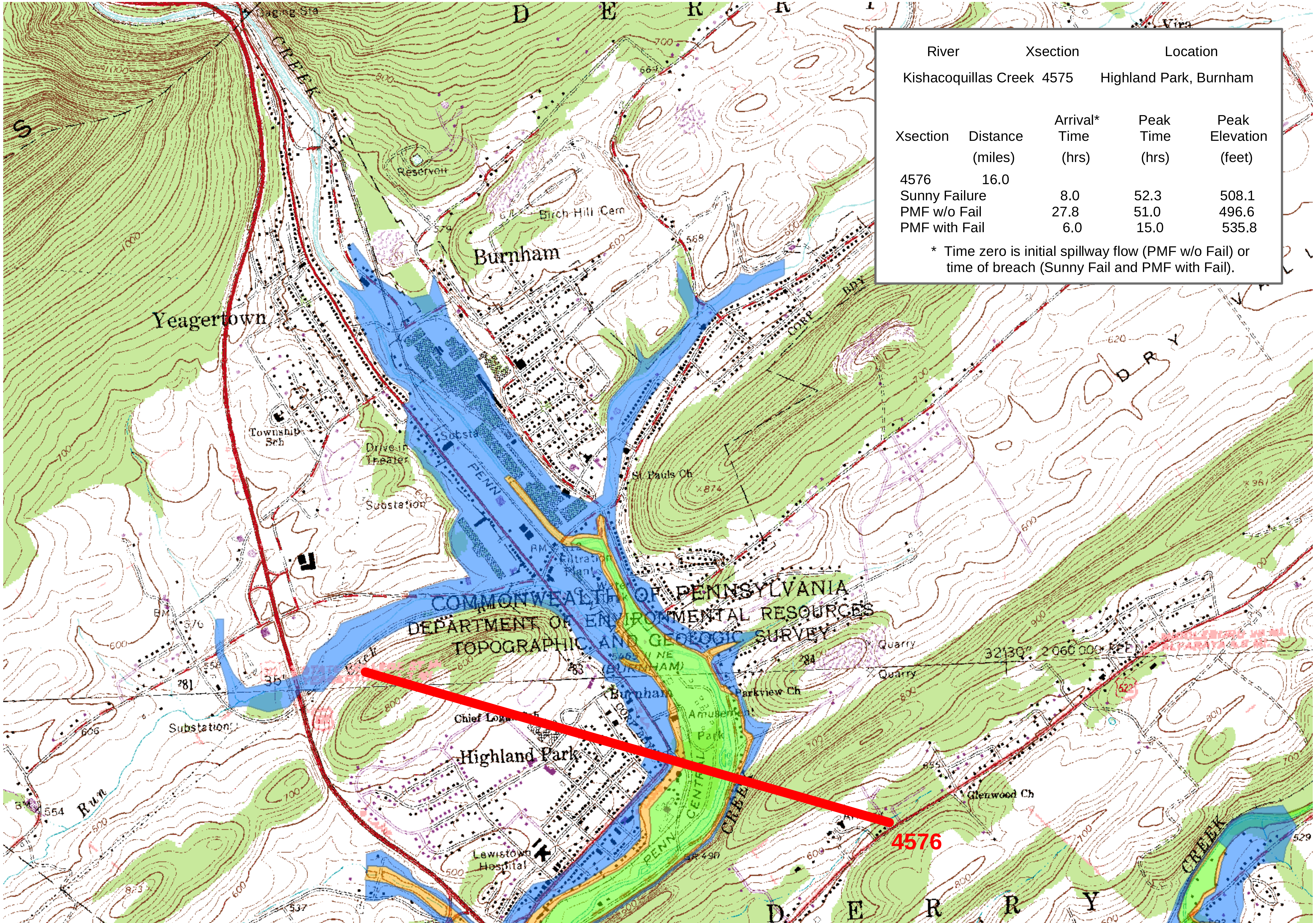
Plate 24

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 23

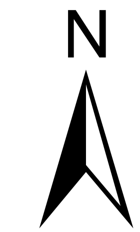
end of study



River	Xsection	Location
Kishacoquillas Creek	4575	Highland Park, Burnham

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
4576	16.0			
Sunny Failure		8.0	52.3	508.1
PMF w/o Fail		27.8	51.0	496.6
PMF with Fail		6.0	15.0	535.8

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



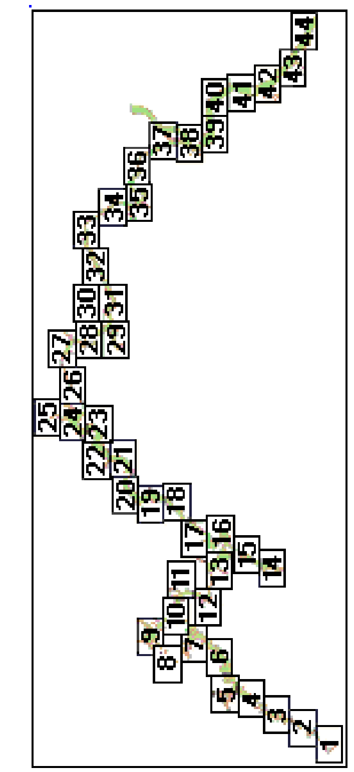


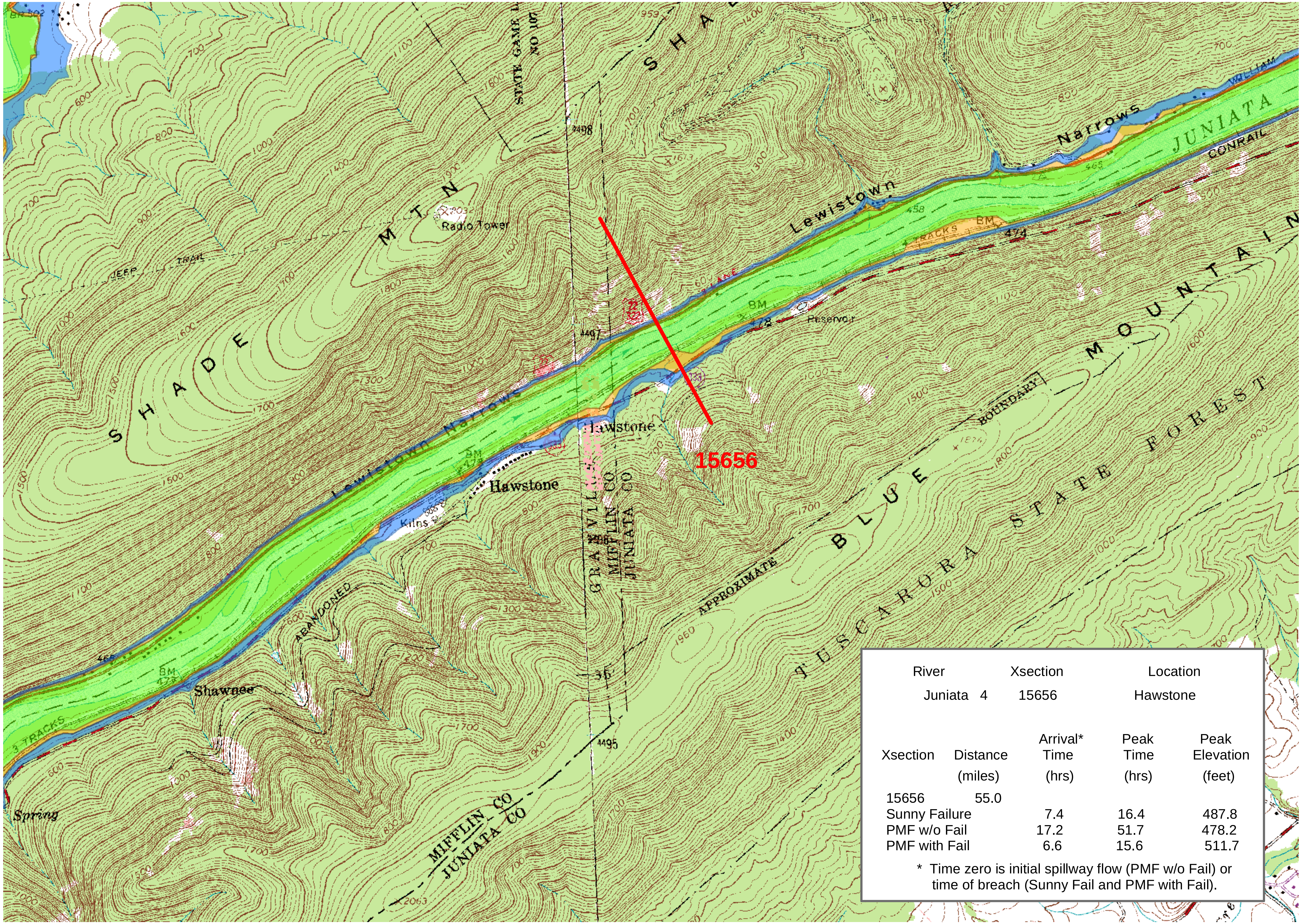
Plate 25

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 24

matches plate 24



River	Xsection	Location
Juniata 4	15656	Hawstone

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
15656	55.0			
Sunny Failure		7.4	16.4	487.8
PMF w/o Fail		17.2	51.7	478.2
PMF with Fail		6.6	15.6	511.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 27

N

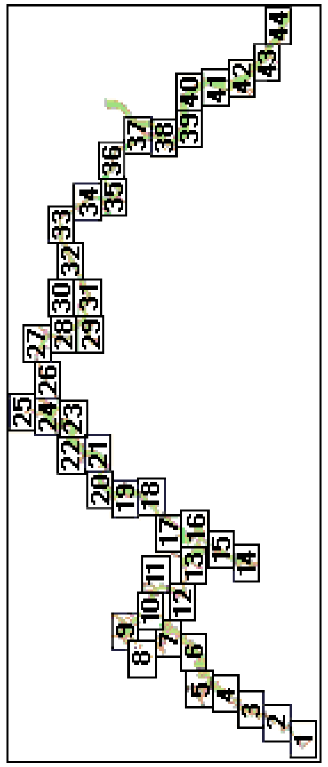
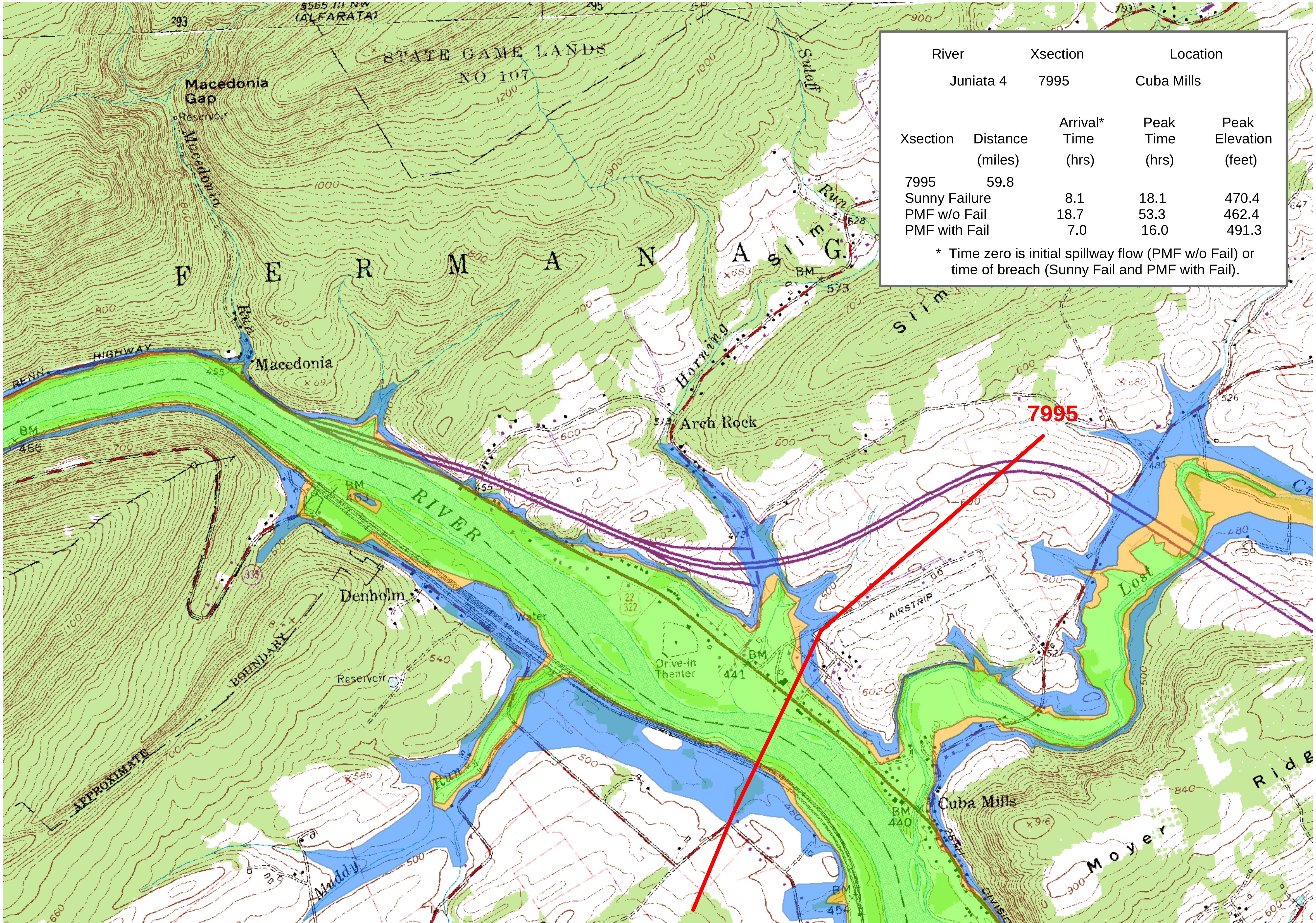


Plate 26

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure



River	Xsection	Location
Juniata 4	7995	Cuba Mills

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
7995	59.8			
Sunny Failure		8.1	18.1	470.4
PMF w/o Fail		18.7	53.3	462.4
PMF with Fail		7.0	16.0	491.3

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

matches plate 26

matches plate 28

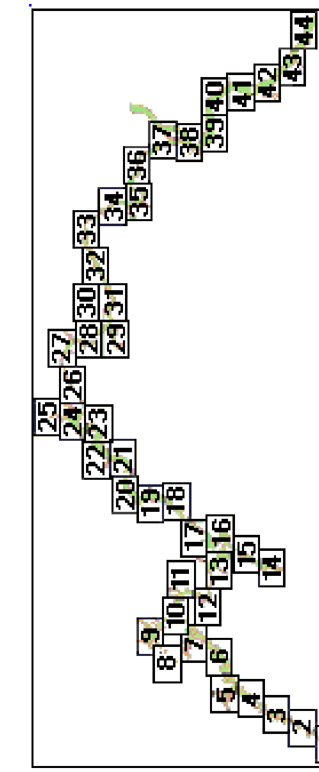
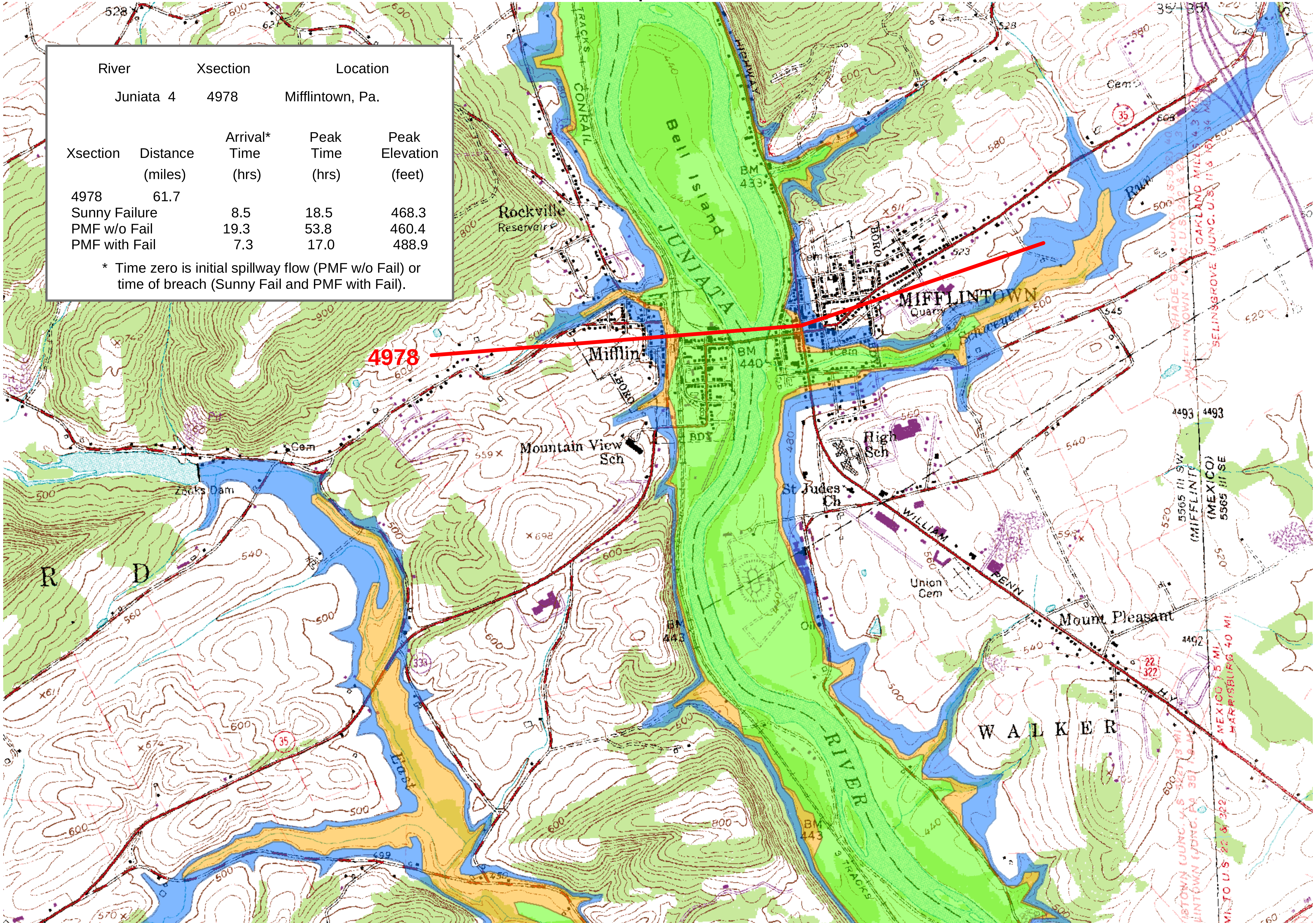


Plate 27

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 27



River	Xsection	Location
Juniata 4	4978	Mifflintown, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
4978	61.7			
Sunny Failure		8.5	18.5	468.3
PMF w/o Fail		19.3	53.8	460.4
PMF with Fail		7.3	17.0	488.9

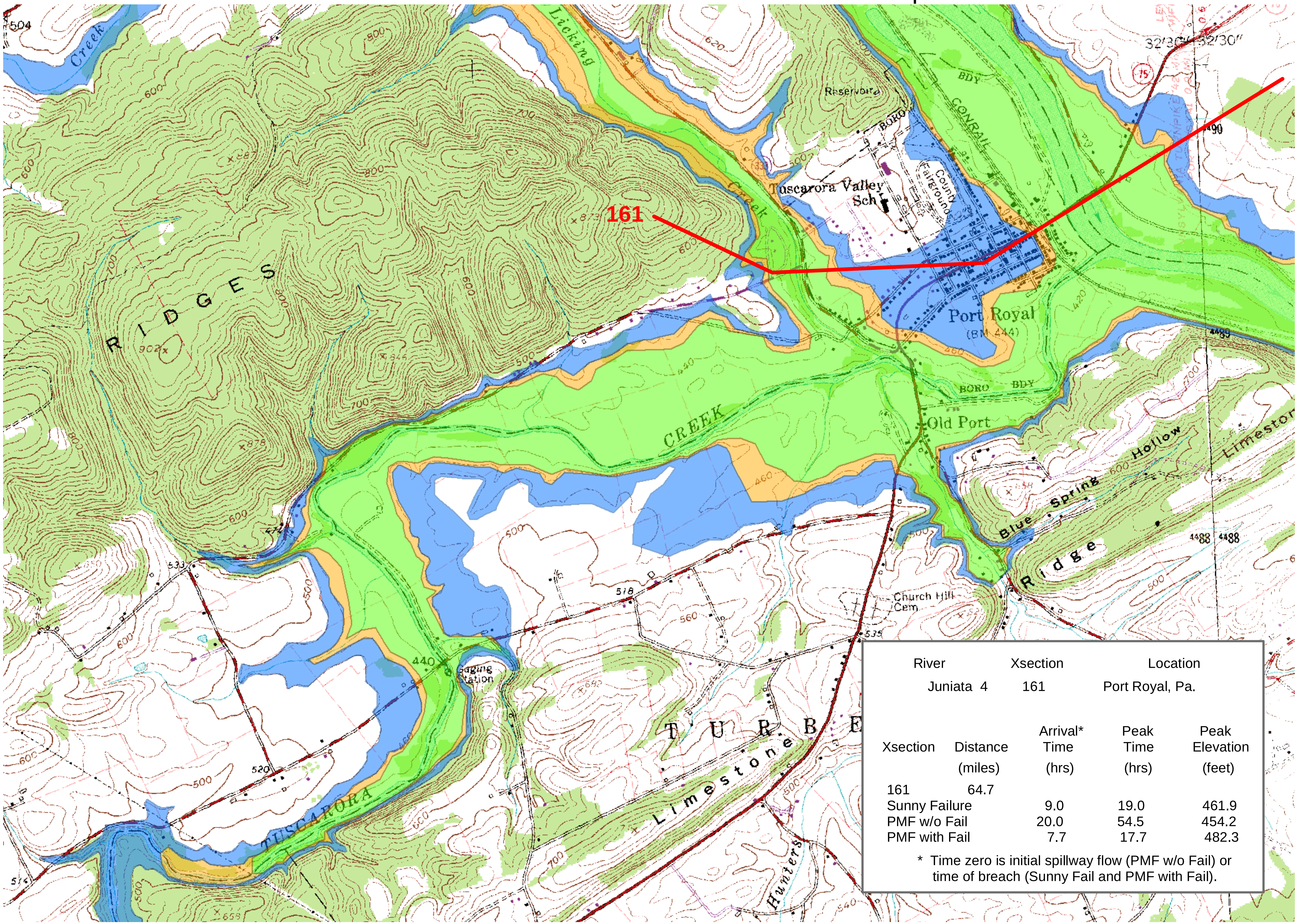
* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 29

Plate 28

Legend
- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 28



matches plate 31

N

River	Xsection	Location
Juniata 4	161	Port Royal, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
161	64.7			
Sunny Failure		9.0	19.0	461.9
PMF w/o Fail		20.0	54.5	454.2
PMF with Fail		7.7	17.7	482.3

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

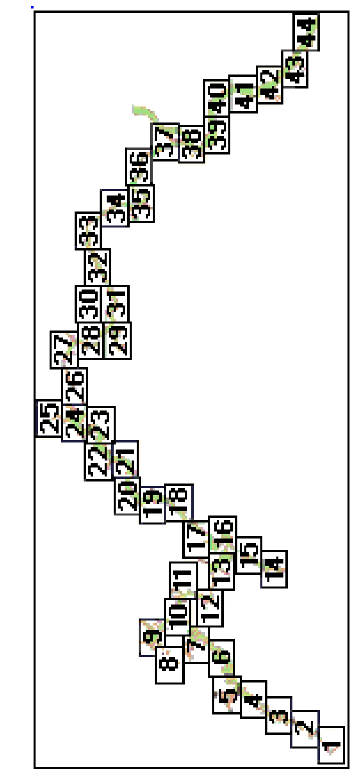
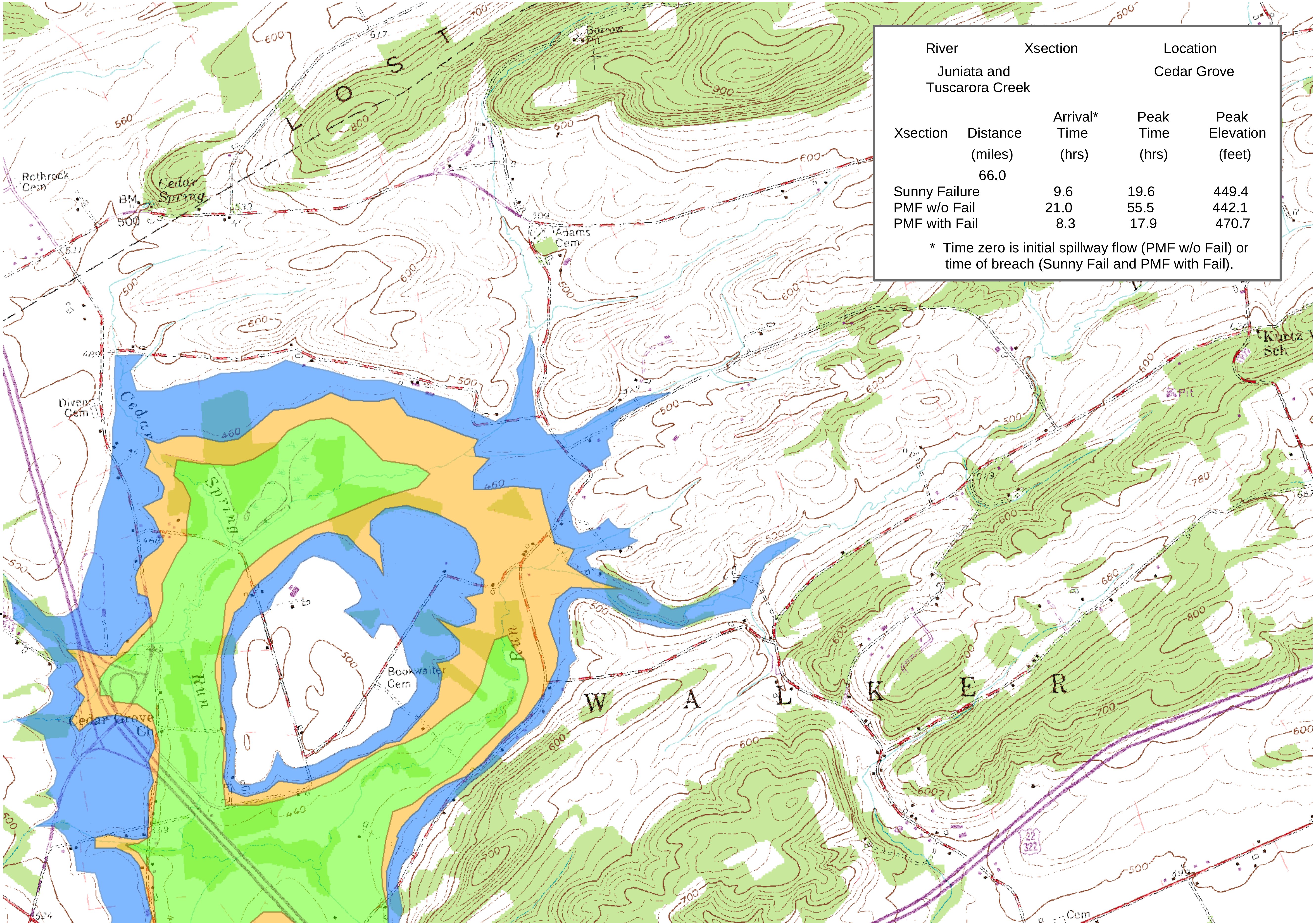


Plate 29

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure



River	Xsection	Location
Juniata and Tuscarora Creek		Cedar Grove

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
	66.0			
Sunny Failure		9.6	19.6	449.4
PMF w/o Fail		21.0	55.5	442.1
PMF with Fail		8.3	17.9	470.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

matches plate 28

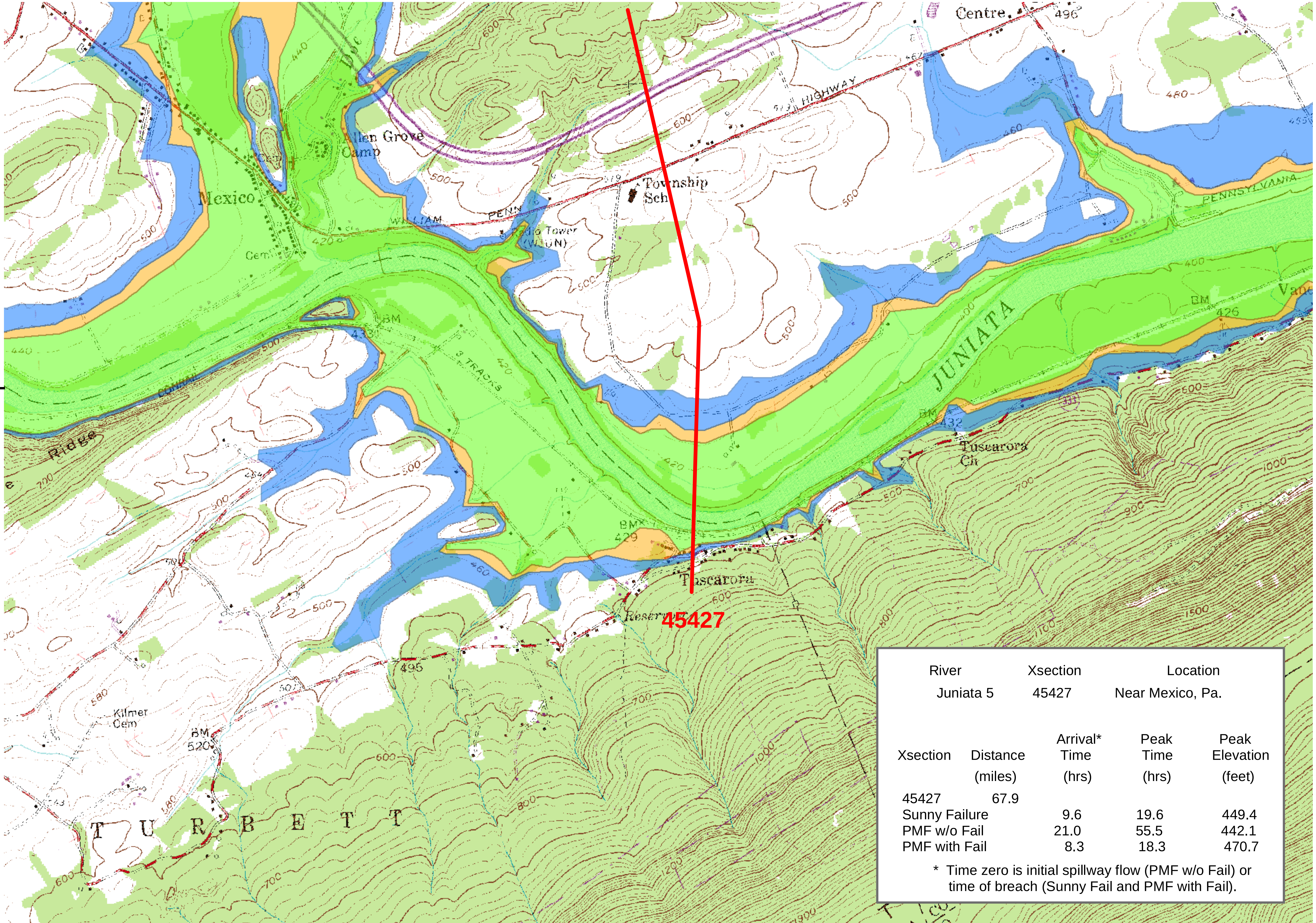
matches plate 31

Plate 30

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 30



River	Xsection	Location
Juniata 5	45427	Near Mexico, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
45427	67.9			
Sunny Failure		9.6	19.6	449.4
PMF w/o Fail		21.0	55.5	442.1
PMF with Fail		8.3	18.3	470.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 32

N

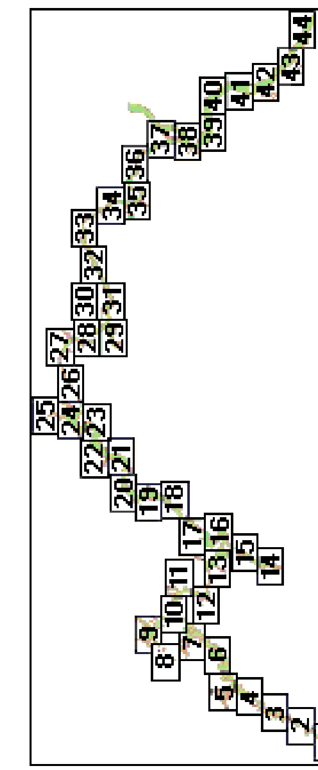
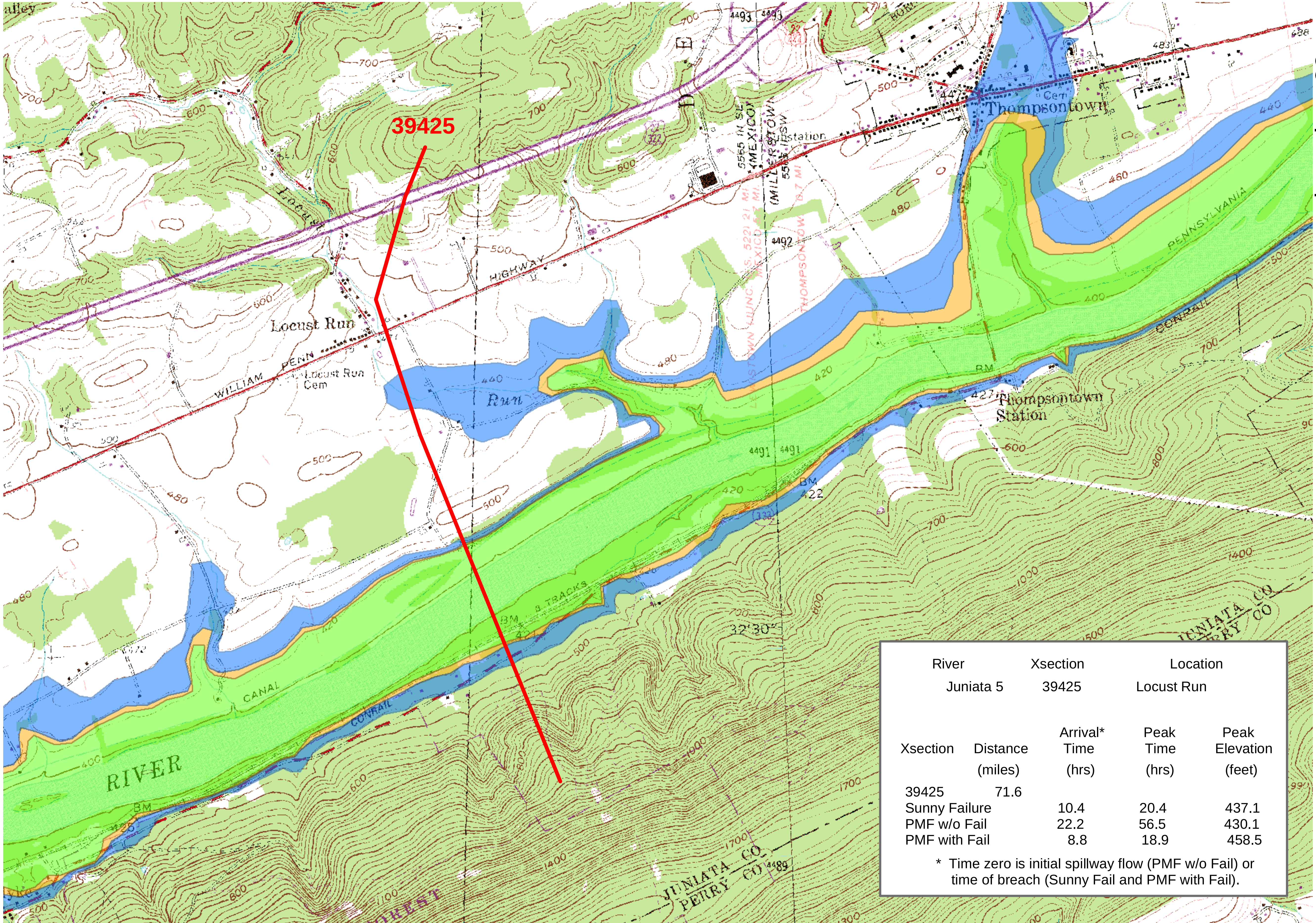


Plate 31

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 31



River	Xsection	Location
Juniata 5	39425	Locust Run

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
39425	71.6			
Sunny Failure		10.4	20.4	437.1
PMF w/o Fail		22.2	56.5	430.1
PMF with Fail		8.8	18.9	458.5

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 33

N

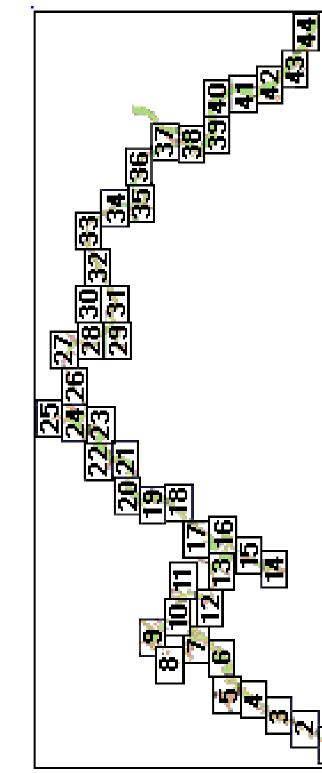


Plate 32

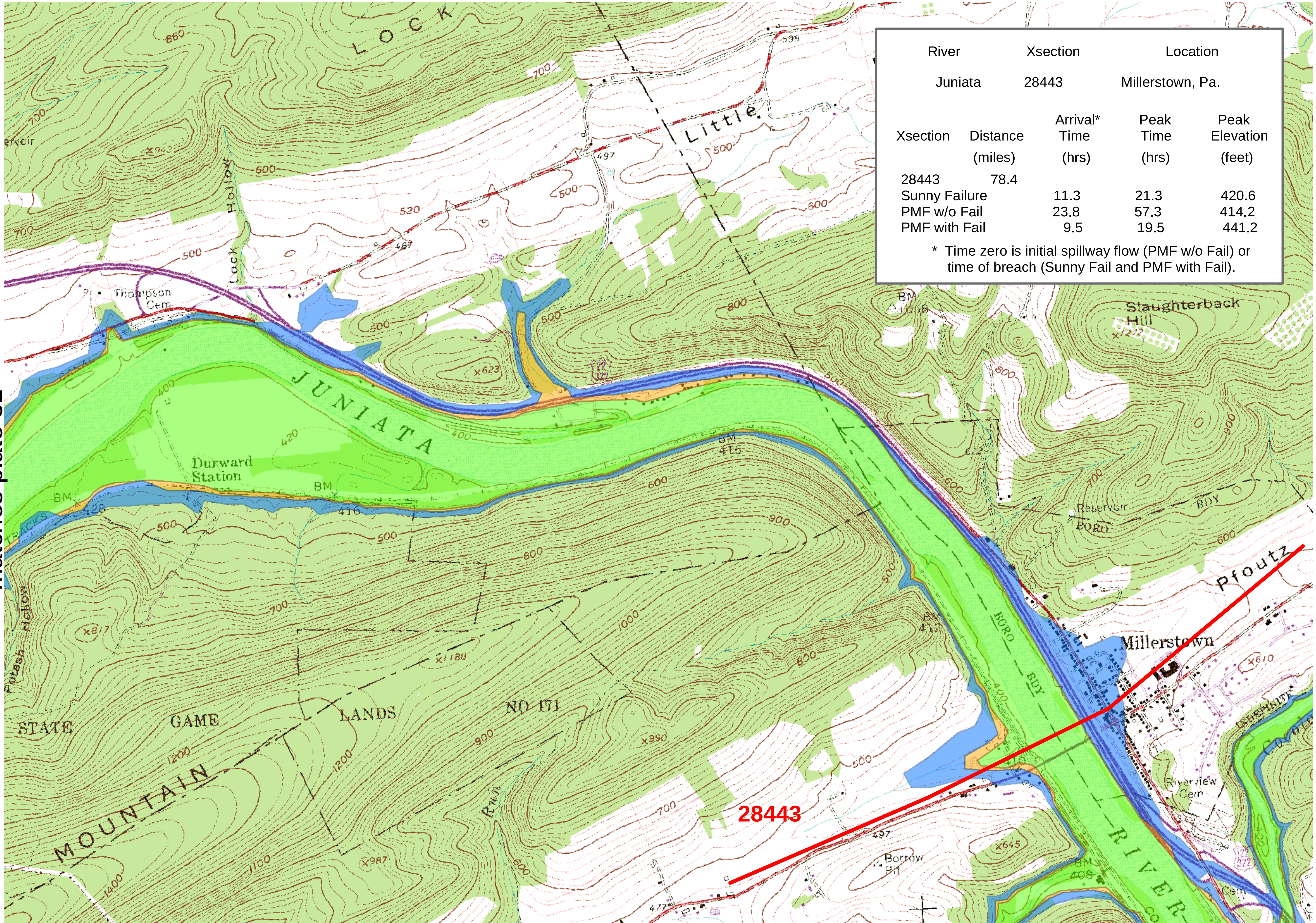
Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

Plate 33

N

matches plate 32

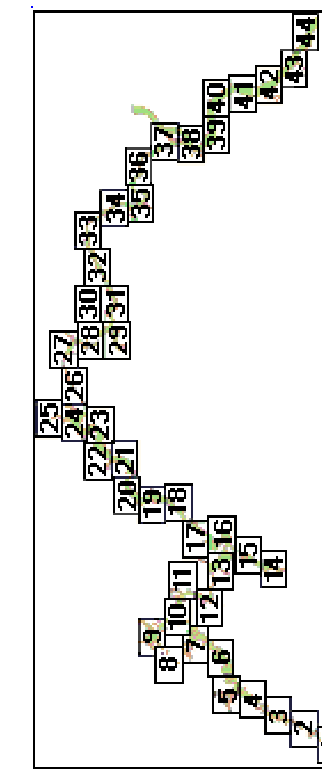


River	Xsection	Location
Juniata	28443	Millerstown, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
28443	78.4			
Sunny Failure		11.3	21.3	420.6
PMF w/o Fail		23.8	57.3	414.2
PMF with Fail		9.5	19.5	441.2

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

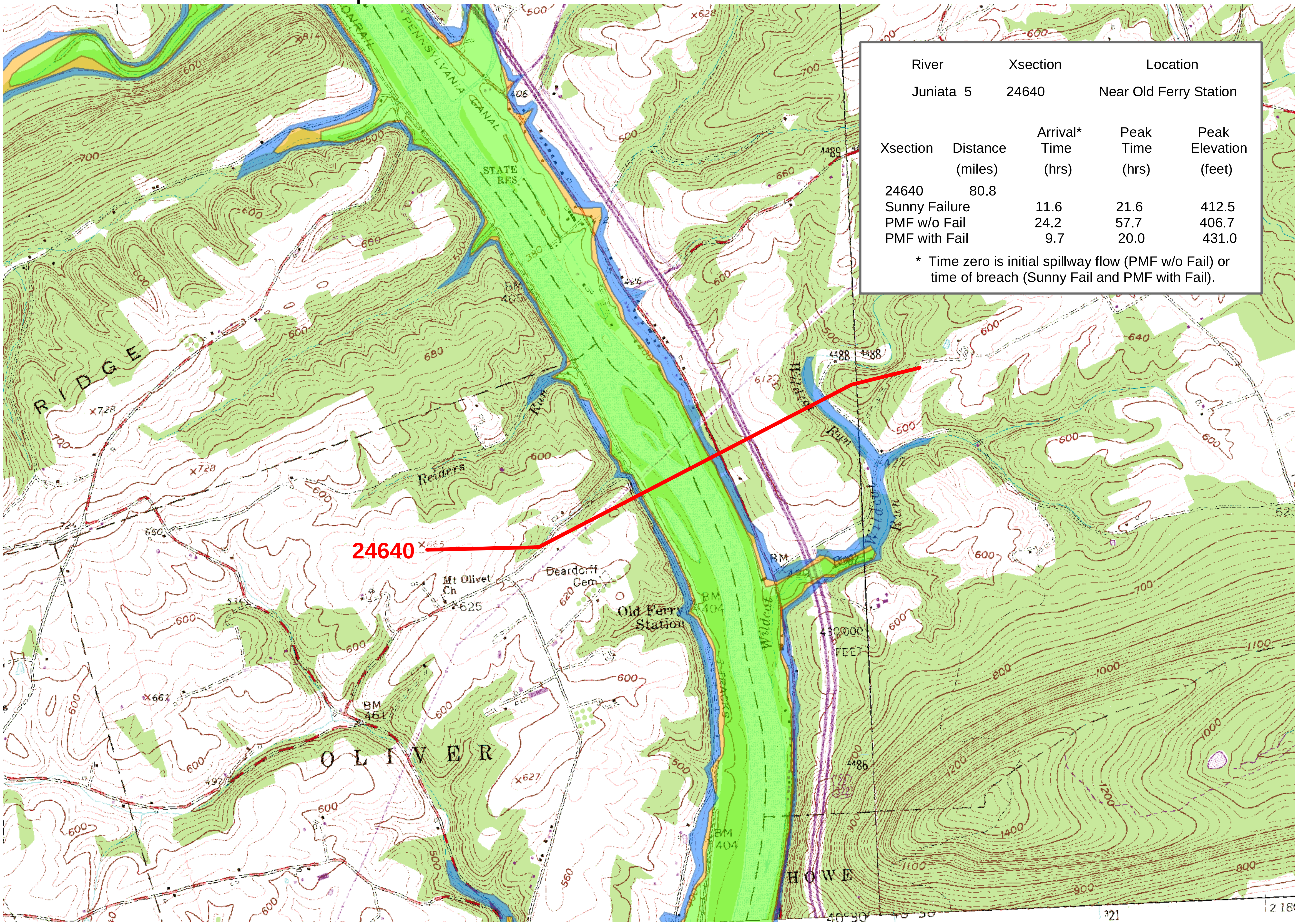
matches plate 34



Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 33



River	Xsection	Location
Juniata 5	24640	Near Old Ferry Station

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
24640	80.8			
Sunny Failure		11.6	21.6	412.5
PMF w/o Fail		24.2	57.7	406.7
PMF with Fail		9.7	20.0	431.0

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

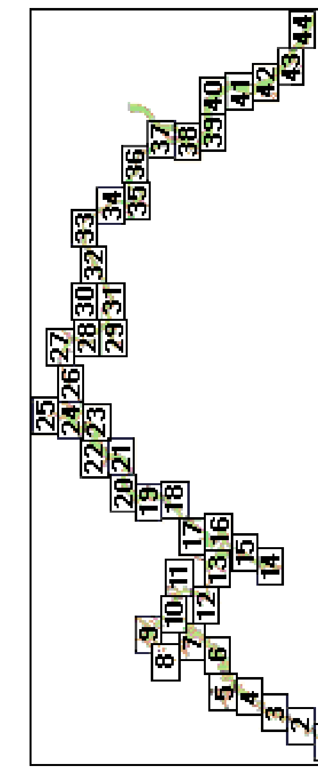


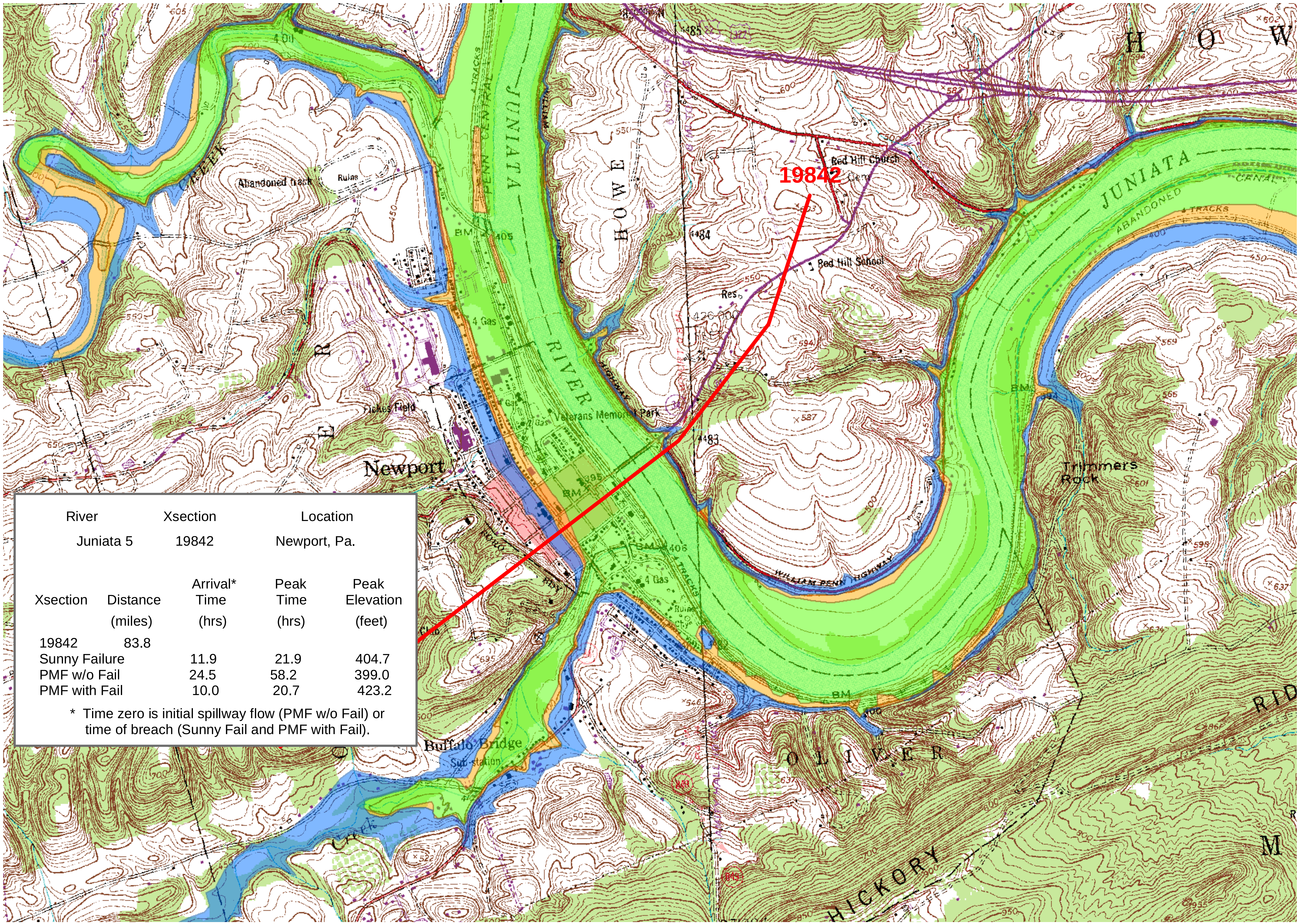
Plate 34

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 35

matches plate 34



matches plate 36

River	Xsection	Location
Juniata 5	19842	Newport, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
19842	83.8			
Sunny Failure		11.9	21.9	404.7
PMF w/o Fail		24.5	58.2	399.0
PMF with Fail		10.0	20.7	423.2

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

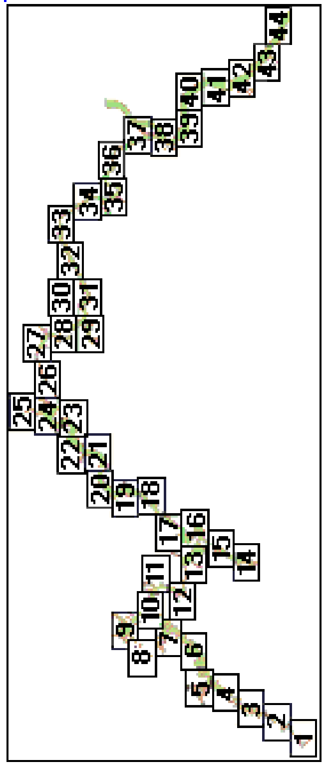
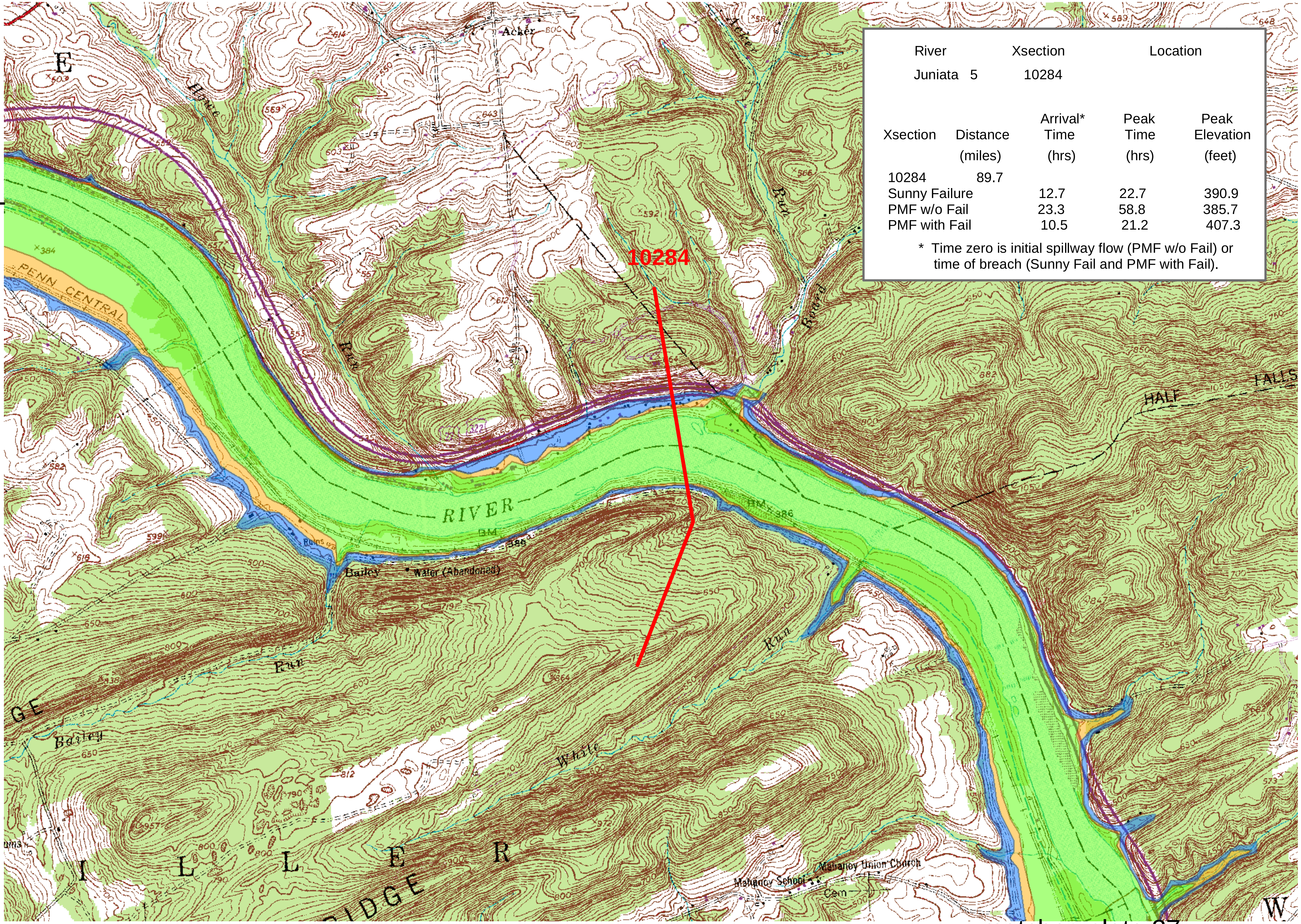


Plate 35

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 35



River	Xsection	Location		
Juniata 5	10284			
Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
10284	89.7			
Sunny Failure		12.7	22.7	390.9
PMF w/o Fail		23.3	58.8	385.7
PMF with Fail		10.5	21.2	407.3

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

N

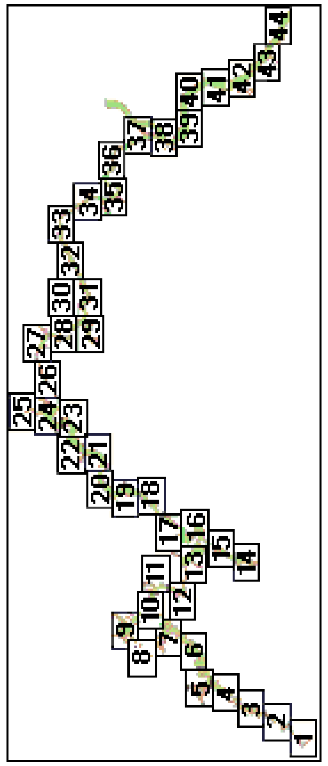


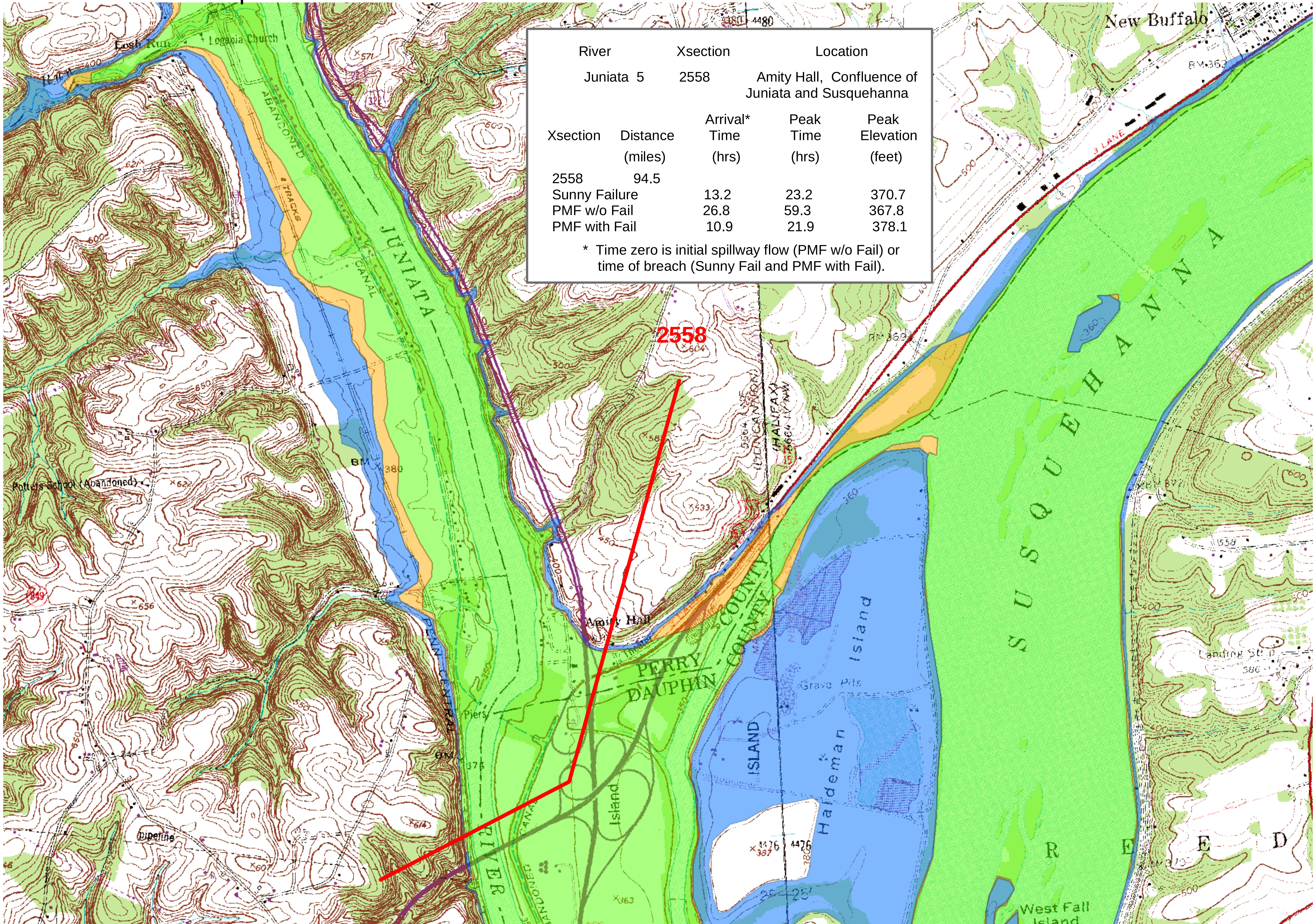
Plate 36

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 37

matches plate 36

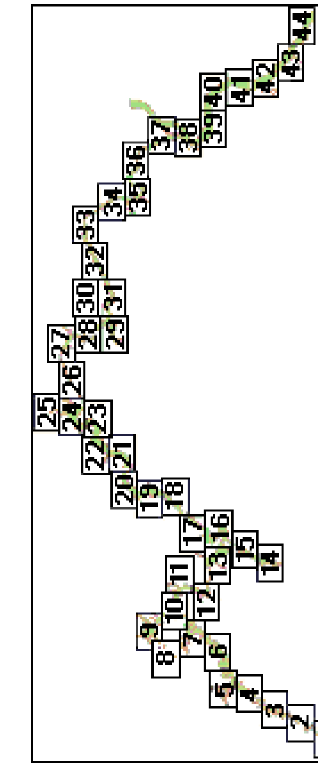


River	Xsection	Location
Juniata 5	2558	Amity Hall, Confluence of Juniata and Susquehanna

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
2558	94.5			
Sunny Failure		13.2	23.2	370.7
PMF w/o Fail		26.8	59.3	367.8
PMF with Fail		10.9	21.9	378.1

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 38



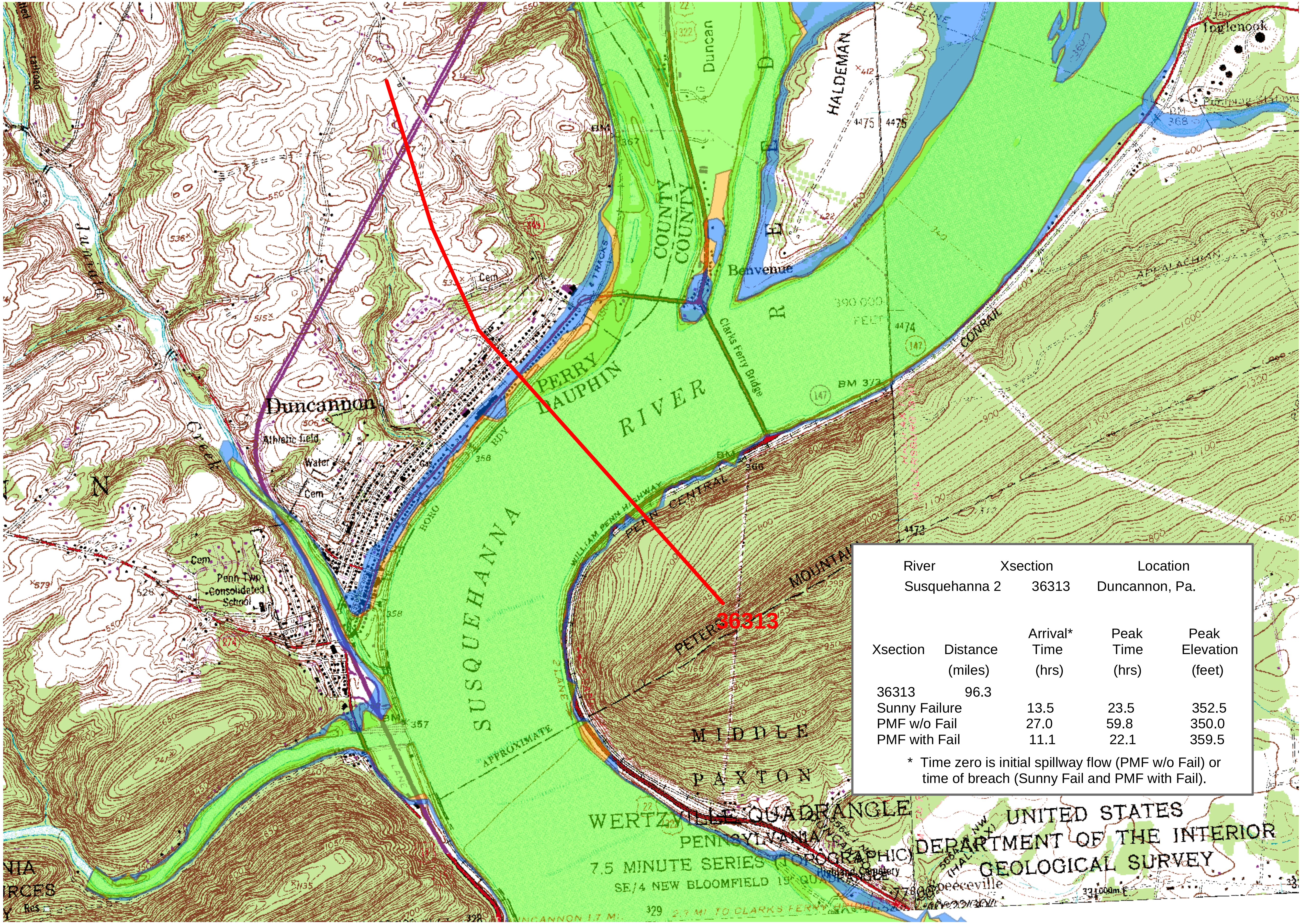
N

Plate 37

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

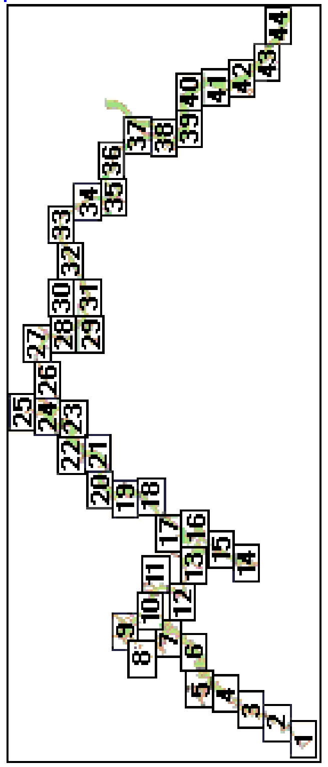
matches plate 37



River	Xsection	Location
Susquehanna 2	36313	Duncannon, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
36313	96.3			
Sunny Failure		13.5	23.5	352.5
PMF w/o Fail		27.0	59.8	350.0
PMF with Fail		11.1	22.1	359.5

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



N

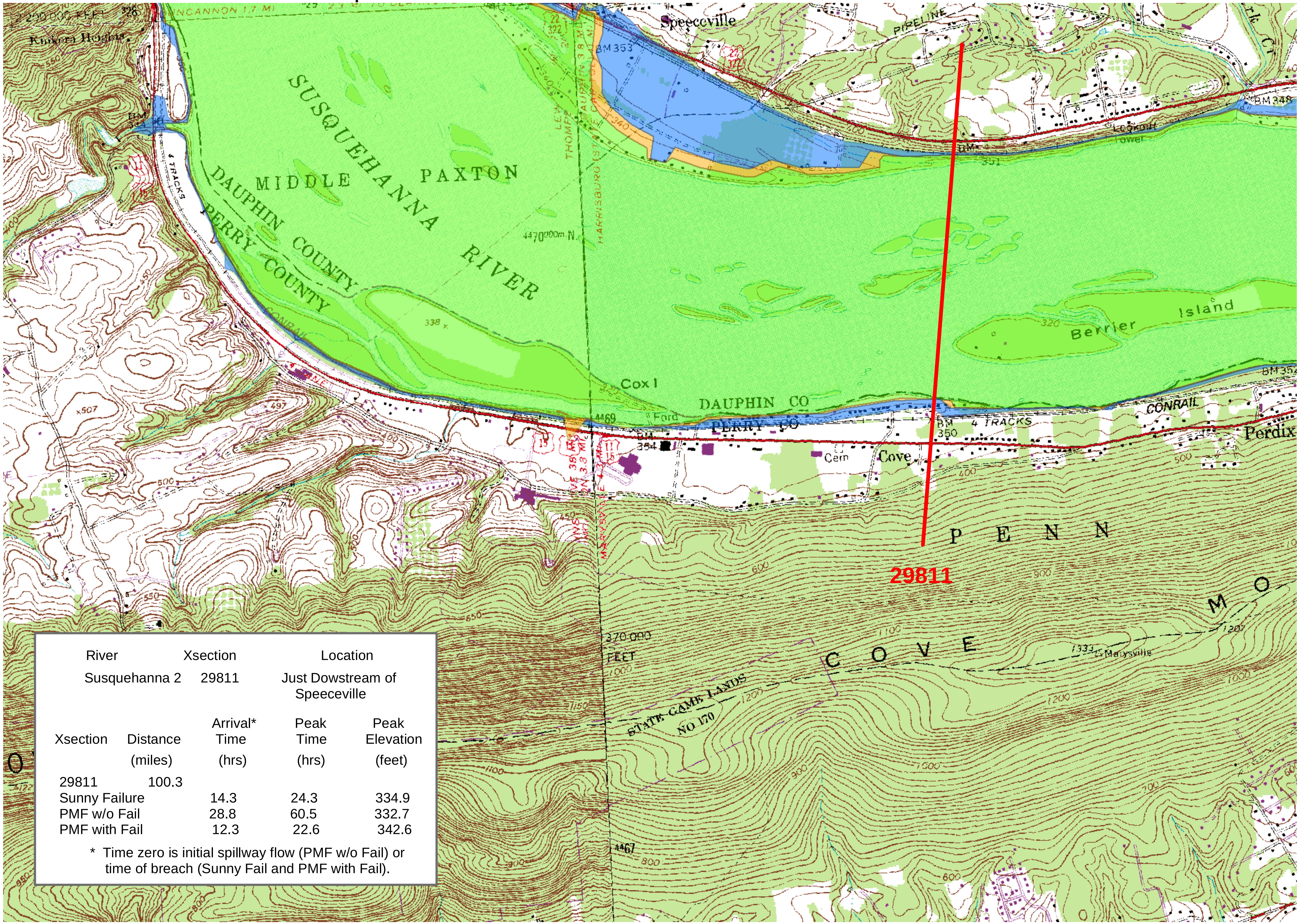
Plate 38

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 39

matches plate 38



River	Xsection	Location
Susquehanna 2	29811	Just Dowstream of Speeceville

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
29811	100.3			
Sunny Failure		14.3	24.3	334.9
PMF w/o Fail		28.8	60.5	332.7
PMF with Fail		12.3	22.6	342.6

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 40

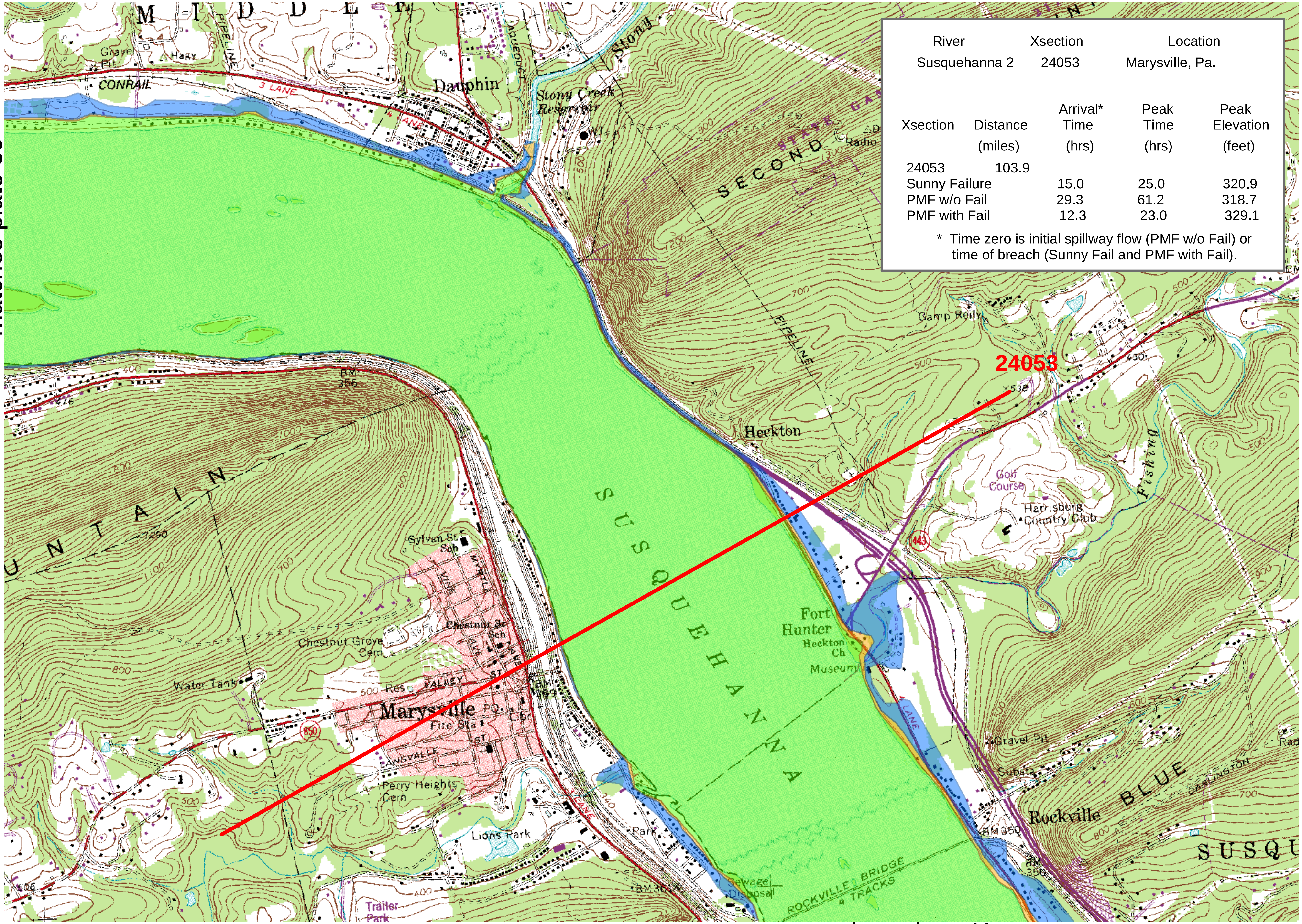
N

Plate 39

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 39



River	Xsection	Location
Susquehanna 2	24053	Marysville, Pa.

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
24053	103.9			
Sunny Failure		15.0	25.0	320.9
PMF w/o Fail		29.3	61.2	318.7
PMF with Fail		12.3	23.0	329.1

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 41

N

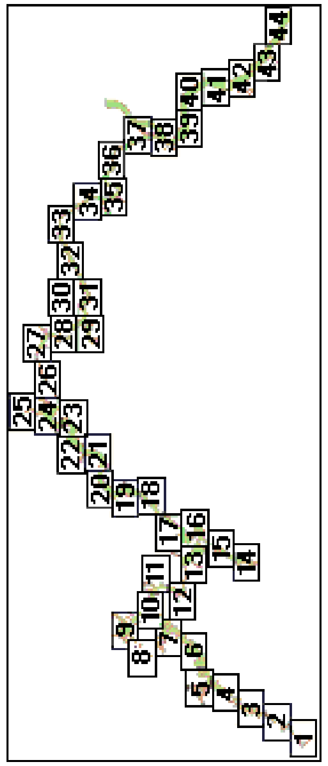
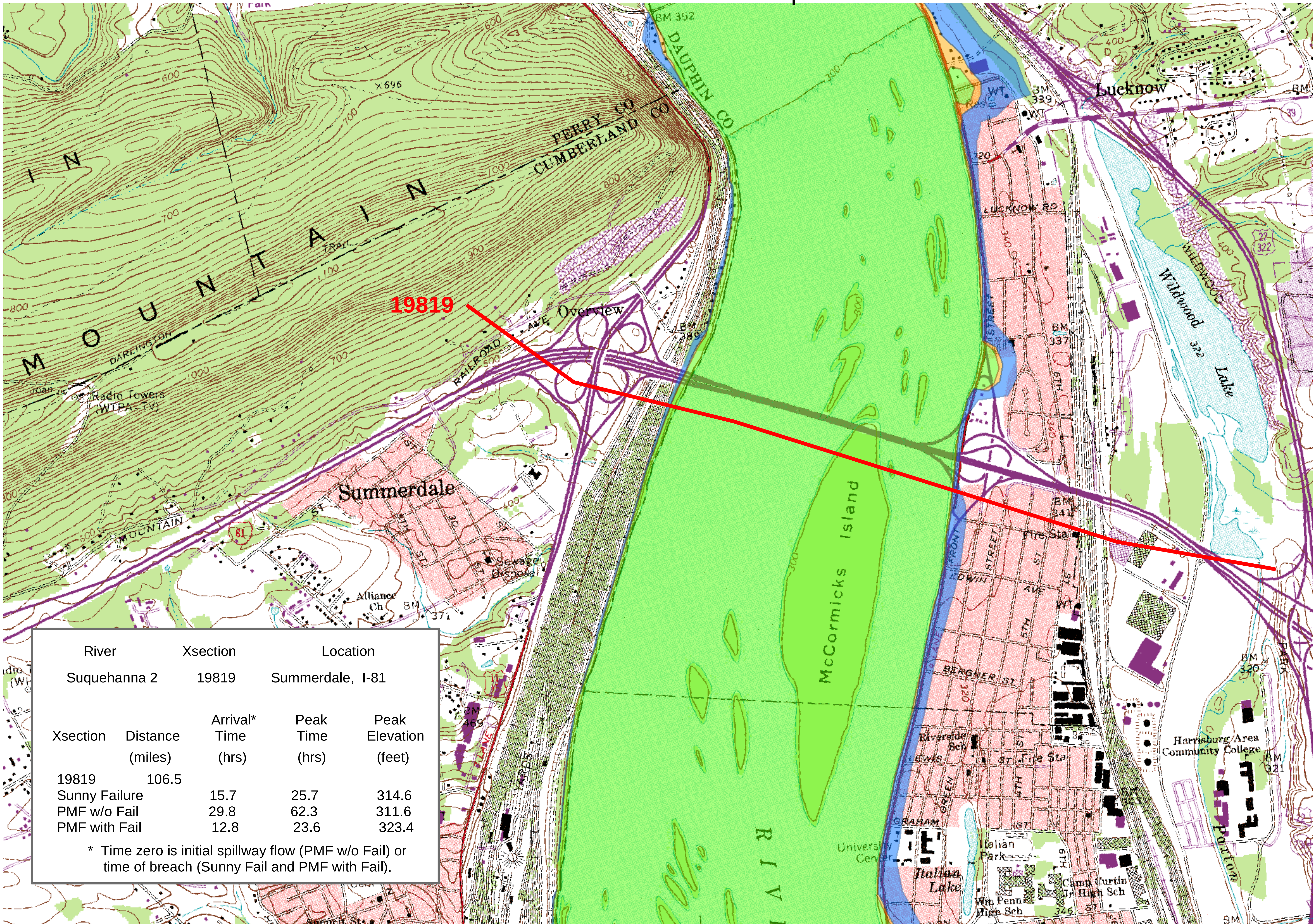


Plate 40

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 40



River	Xsection	Location
Suquehanna 2	19819	Summerdale, I-81

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
19819	106.5			
Sunny Failure		15.7	25.7	314.6
PMF w/o Fail		29.8	62.3	311.6
PMF with Fail		12.8	23.6	323.4

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

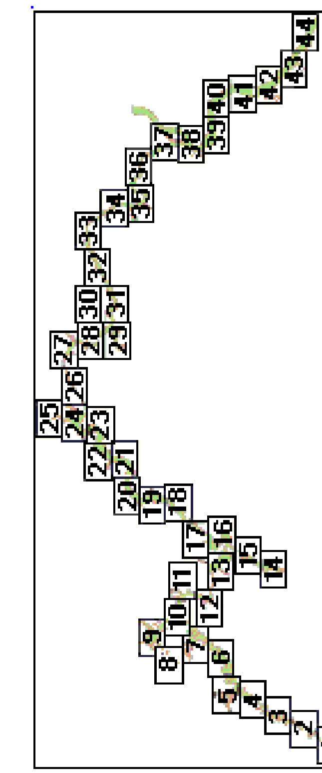


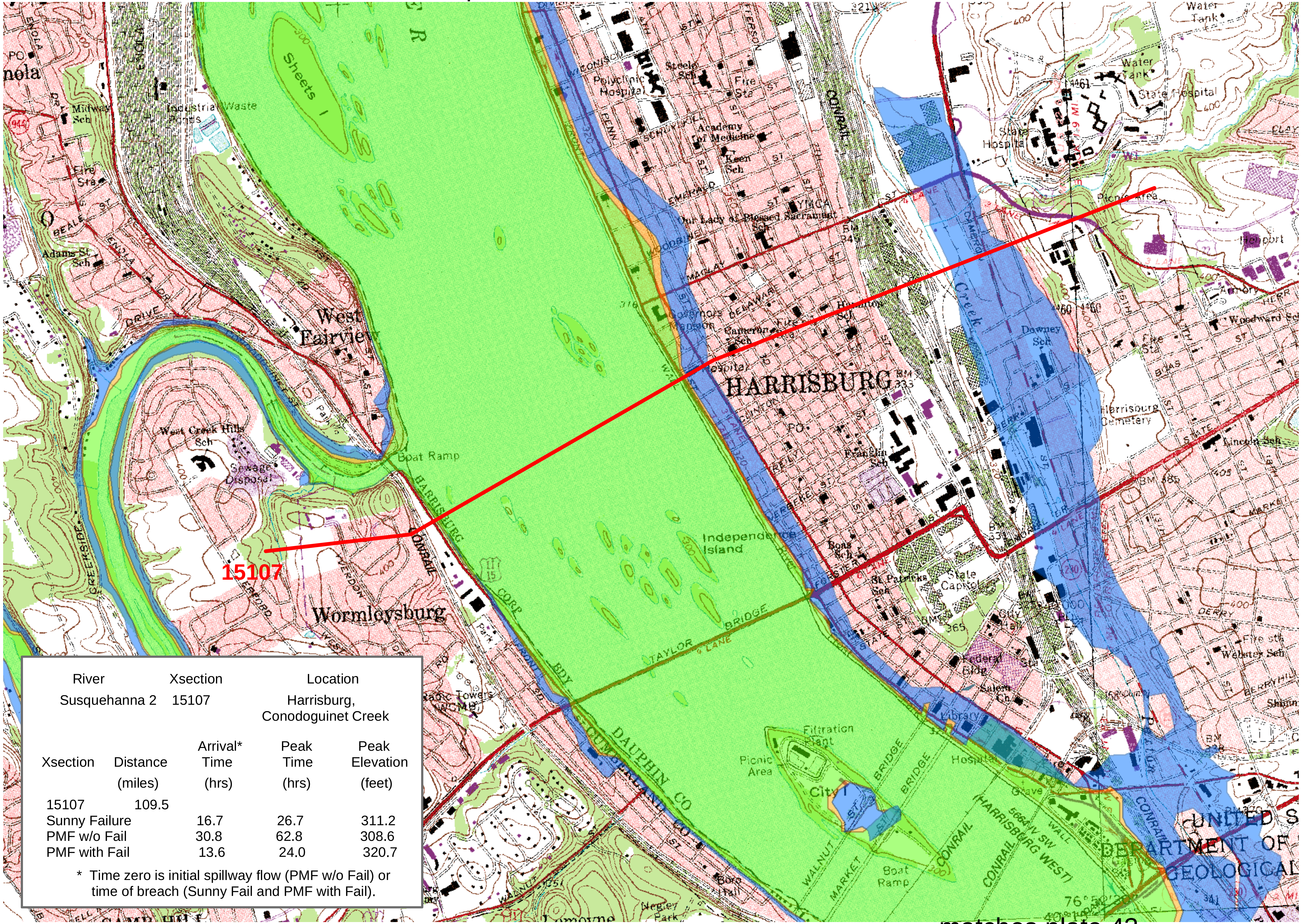
Plate 41

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

matches plate 42

matches plate 41



River	Xsection	Location
Susquehanna 2	15107	Harrisburg, Conodoguinet Creek

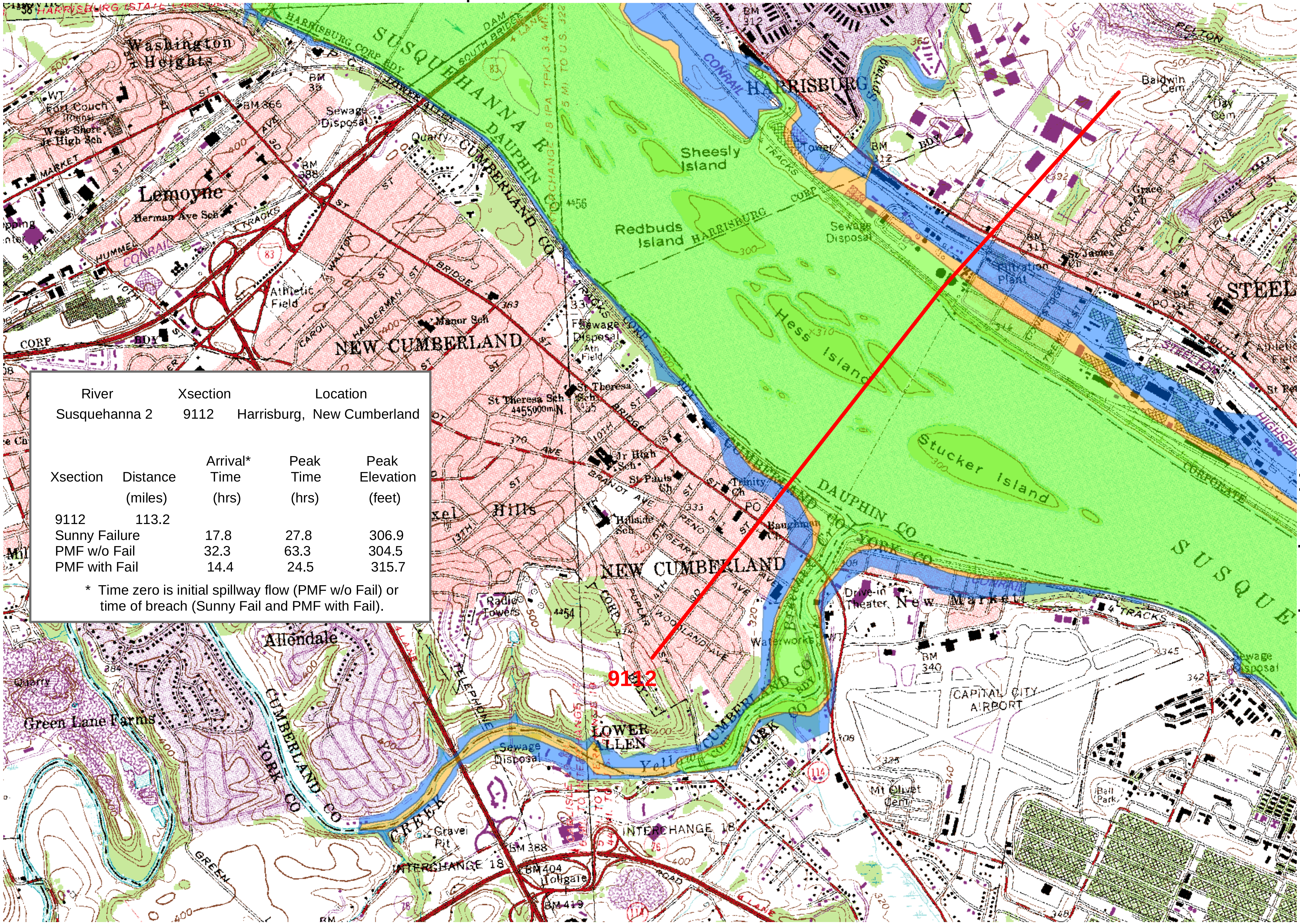
Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
15107	109.5			
Sunny Failure		16.7	26.7	311.2
PMF w/o Fail		30.8	62.8	308.6
PMF with Fail		13.6	24.0	320.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

Plate 42

matches plate 43

matches plate 42

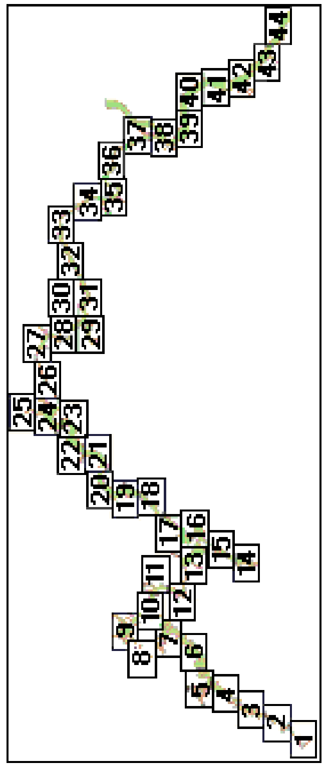


River	Xsection	Location
Susquehanna 2	9112	Harrisburg, New Cumberland

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
9112	113.2			
Sunny Failure		17.8	27.8	306.9
PMF w/o Fail		32.3	63.3	304.5
PMF with Fail		14.4	24.5	315.7

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).

matches plate 44



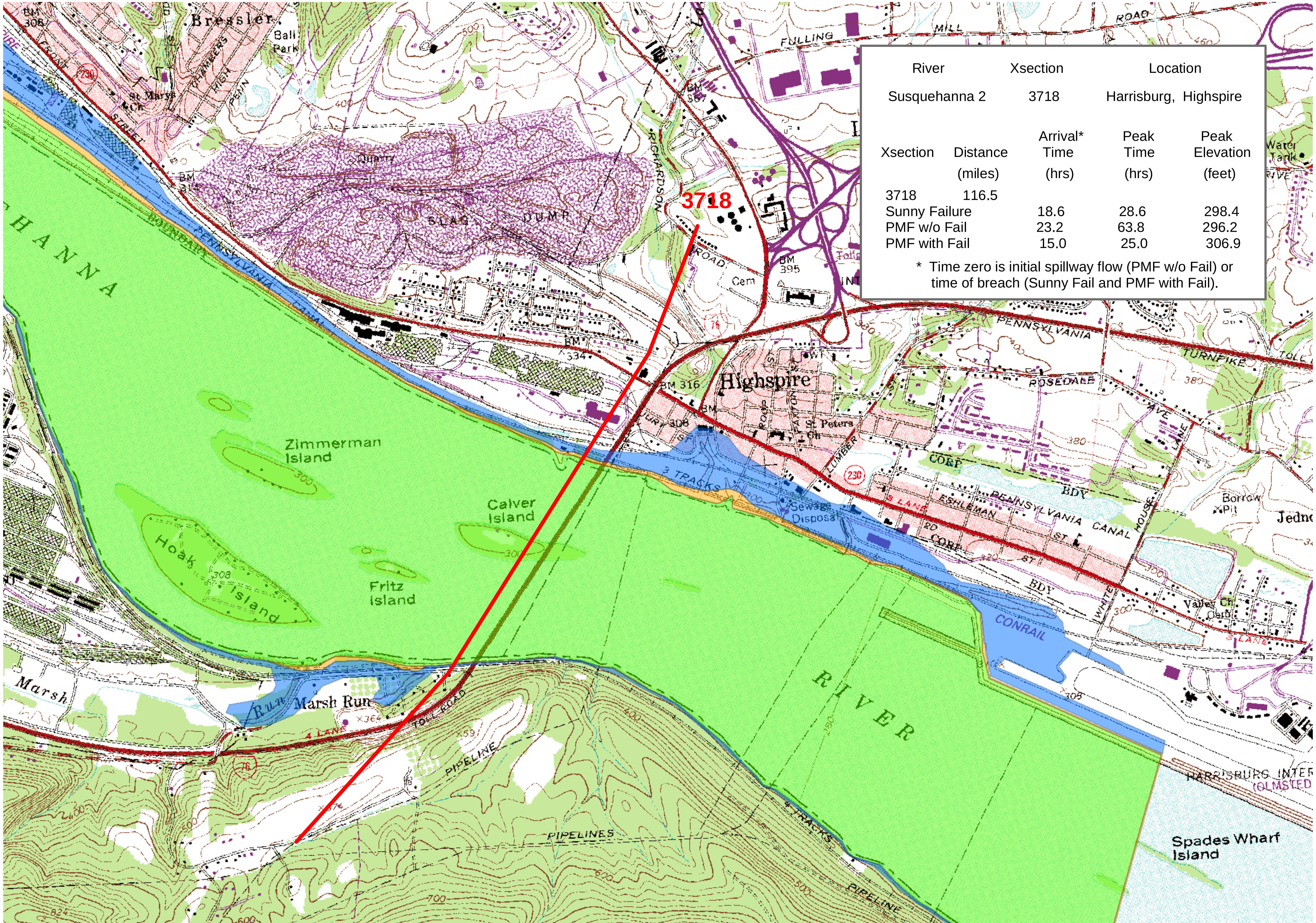
N

Plate 43

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

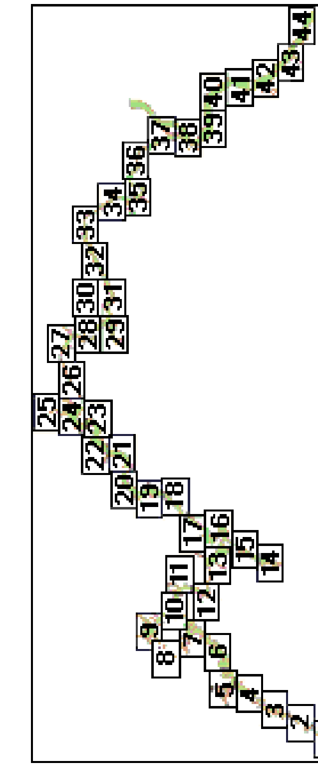
matches plate 43



River	Xsection	Location
Susquehanna 2	3718	Harrisburg, Highspire

Xsection	Distance (miles)	Arrival* Time (hrs)	Peak Time (hrs)	Peak Elevation (feet)
3718	116.5			
Sunny Failure		18.6	28.6	298.4
PMF w/o Fail		23.2	63.8	296.2
PMF with Fail		15.0	25.0	306.9

* Time zero is initial spillway flow (PMF w/o Fail) or time of breach (Sunny Fail and PMF with Fail).



N

Plate 44

Legend

- Sunnyday Failure
- PMF without Failure
- PMF Failure

end of study

USE OF REGULARIZATION AS A METHOD FOR WATERSHED MODEL CALIBRATION

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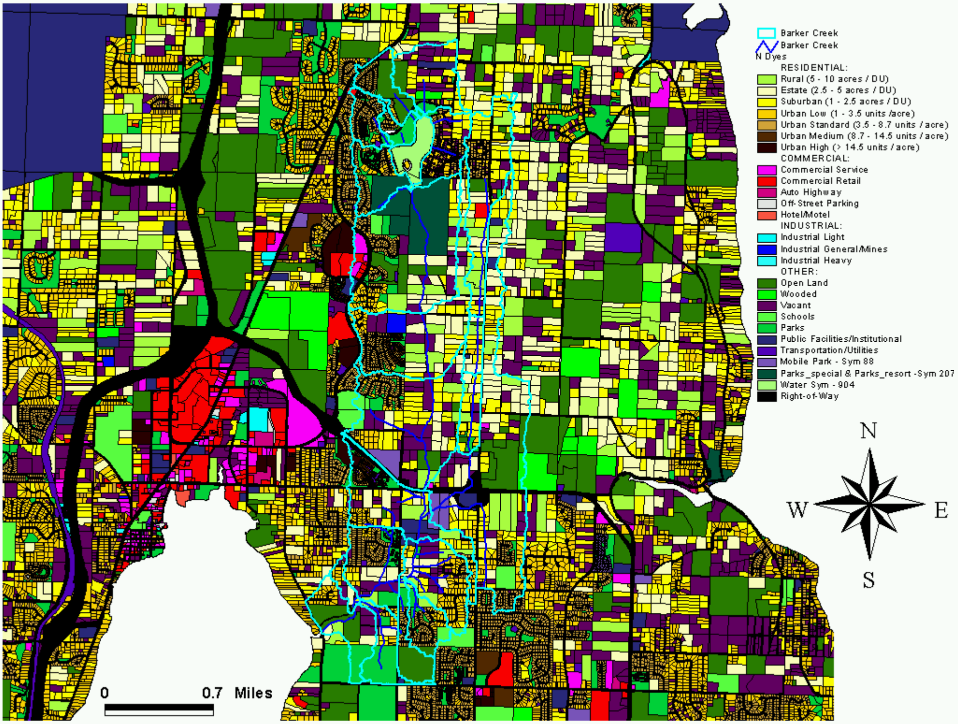
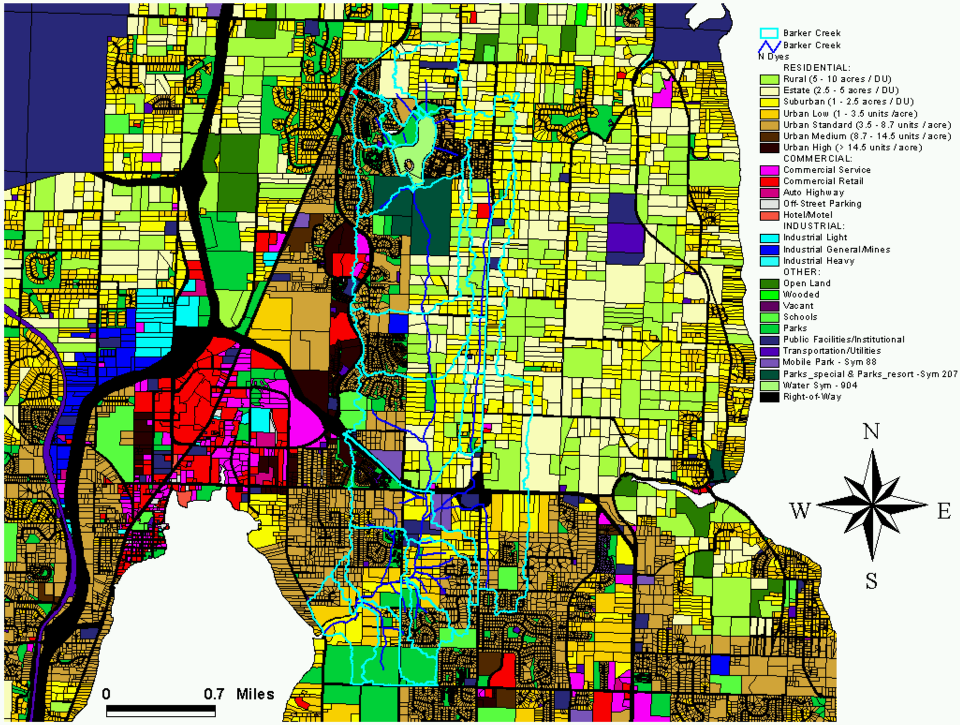
August 2005

MOTIVATION

CURRENT



ALTERNATIVE FUTURE



PROBLEM

DETAILED LANDSCAPE INFO. ENCAPSULATED IN GIS COVERAGES

↓

GIS

↓

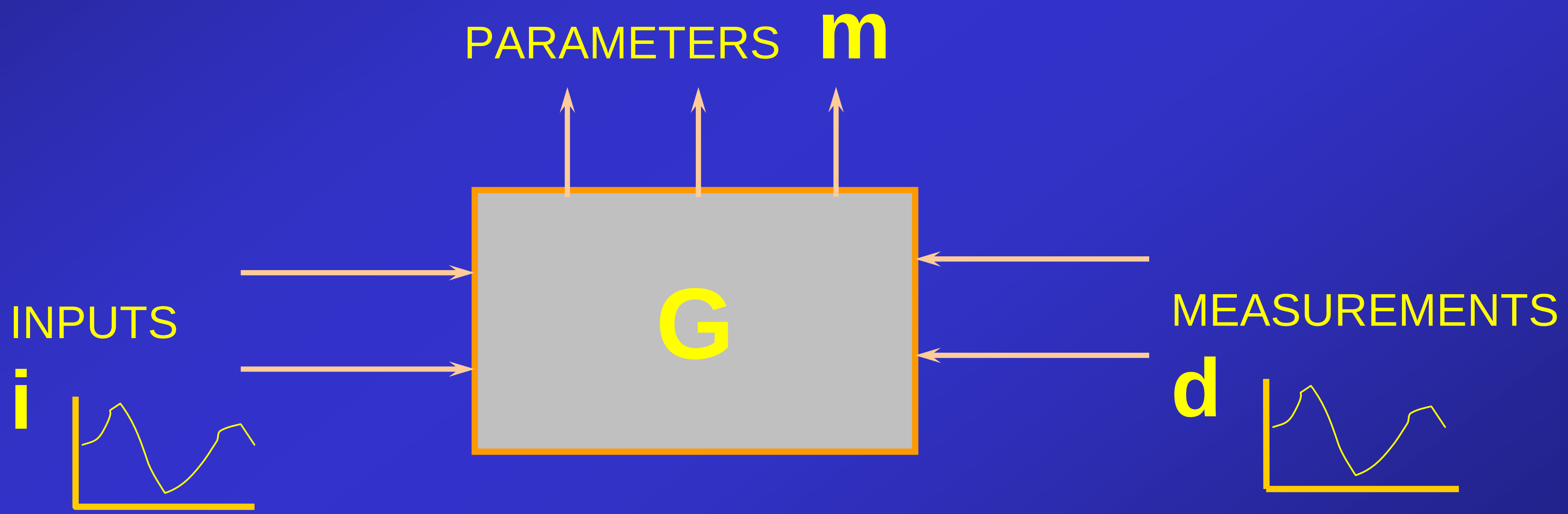
MODEL INPUT FILE

↓

HIGHLY PARAMETERIZED MODEL

CONTEXT

THE INVERSE PROBLEM



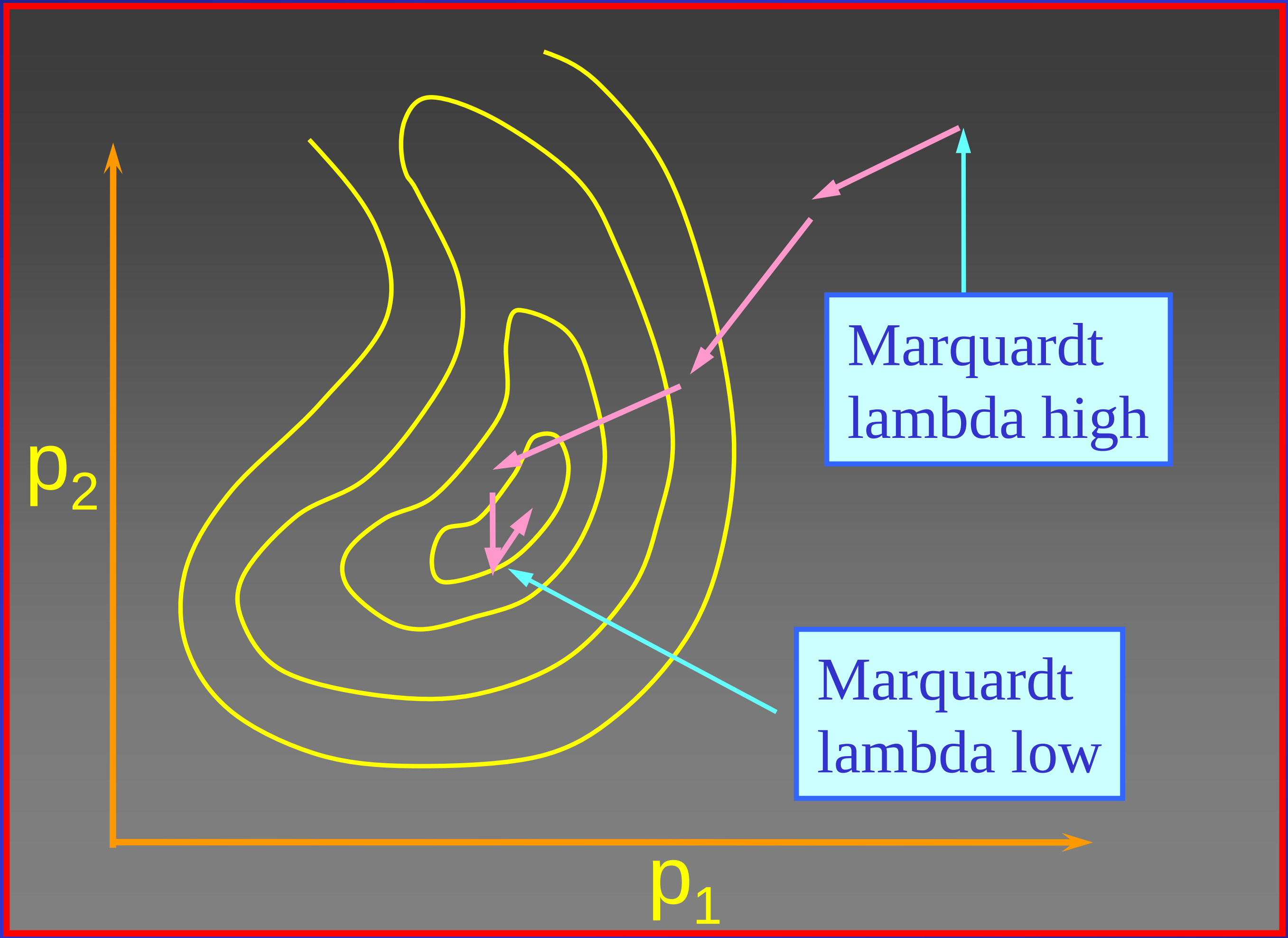
FIND m GIVEN d

US Army Corps of Engineers

CONTEXT

- MODEL TO MEASUREMENT MISFIT QUANTIFIED USING THE LEAST SQUARES SOLUTION
  - HOMOSCEDASCITY CAN BE ACHIEVED THROUGH TRANSFORMATION
  - SERIAL CORRELATION CAN BE ADDRESSED THROUGH EMPLOYMENT OF AN ARMA MODEL
  - IT IS THE MAXIMUM LIKELIHOOD SOLUTION

CONTEXT



Skahill, B., Doherty, J., (2005). "Efficient accommodation of local minima in watershed model calibration" Submitted for publication in Journal of Hydrology.

CONTEXT

$$\Phi = \Sigma\,(w_i r_i)^2$$

$$m - m_0 = (J^t Q J + \lambda I)^{-1} J^t Q (d - d_0)$$

PROBLEM

- THE J^tQJ MATRIX IS ILL-CONDITIONED
  - WHICH OFTEN OCCURS AS MODEL COMPLEXITY GROWS

REGULARIZATION

- A MEASURE OR ADDITIONAL CONSTRAINT THAT IS TAKEN TO ENSURE THAT A STABLE SOLUTION IS OBTAINED TO AN OTHERWISE ILL-POSED INVERSE PROBLEM

EXAMPLE

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2} - v\frac{\partial C}{\partial x}$$

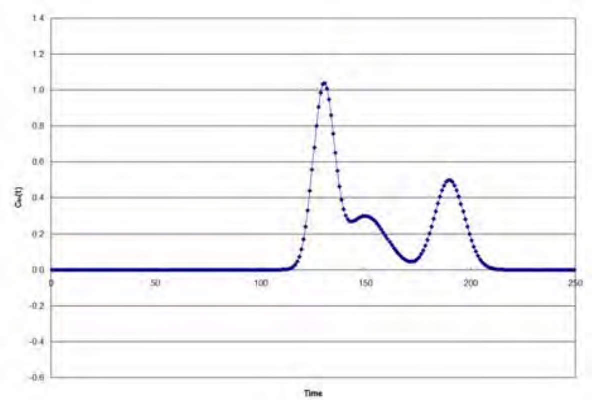
$$C(0,t) = C_{in}(t)$$

$$C(x,t) \to 0 \text{ as } x \to \infty$$

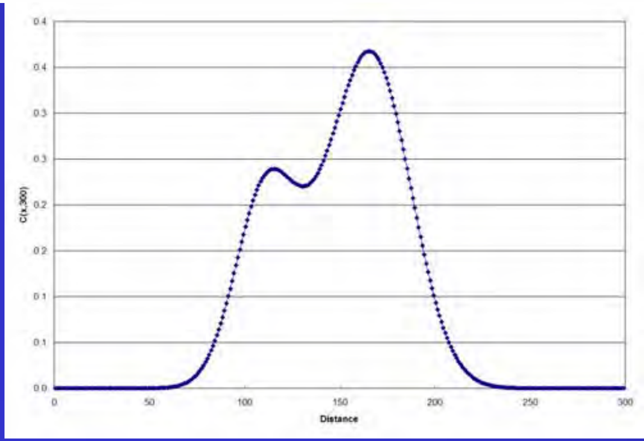
$$C(x,0) = C_0(x)$$

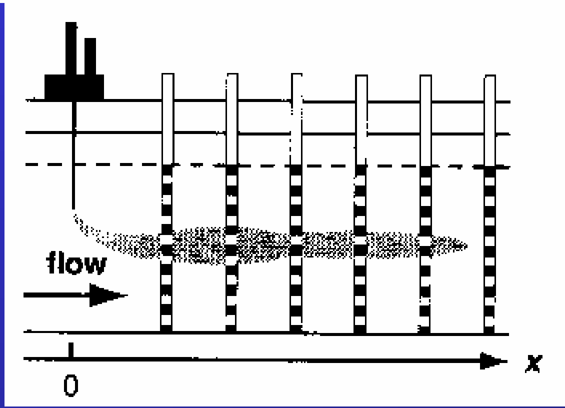
$$C(x,T) = \int_0^T C_{in}(t) f(x, T-t)\, dt, \quad \to \mathbf{d = Gm}$$

$$f(x, T-t) = \frac{x}{2\sqrt{\pi D (T-t)^3}} \exp\left(-\frac{[x - v(T-t)]^2}{4D(T-t)}\right)$$



$$C_{in}(t) = \exp\left(-\frac{(t-130)^2}{2(5)^2}\right) + 0.3\exp\left(-\frac{(t-150)^2}{2(10)^2}\right) + 0.5\exp\left(-\frac{(t-190)^2}{2(7)^2}\right)$$

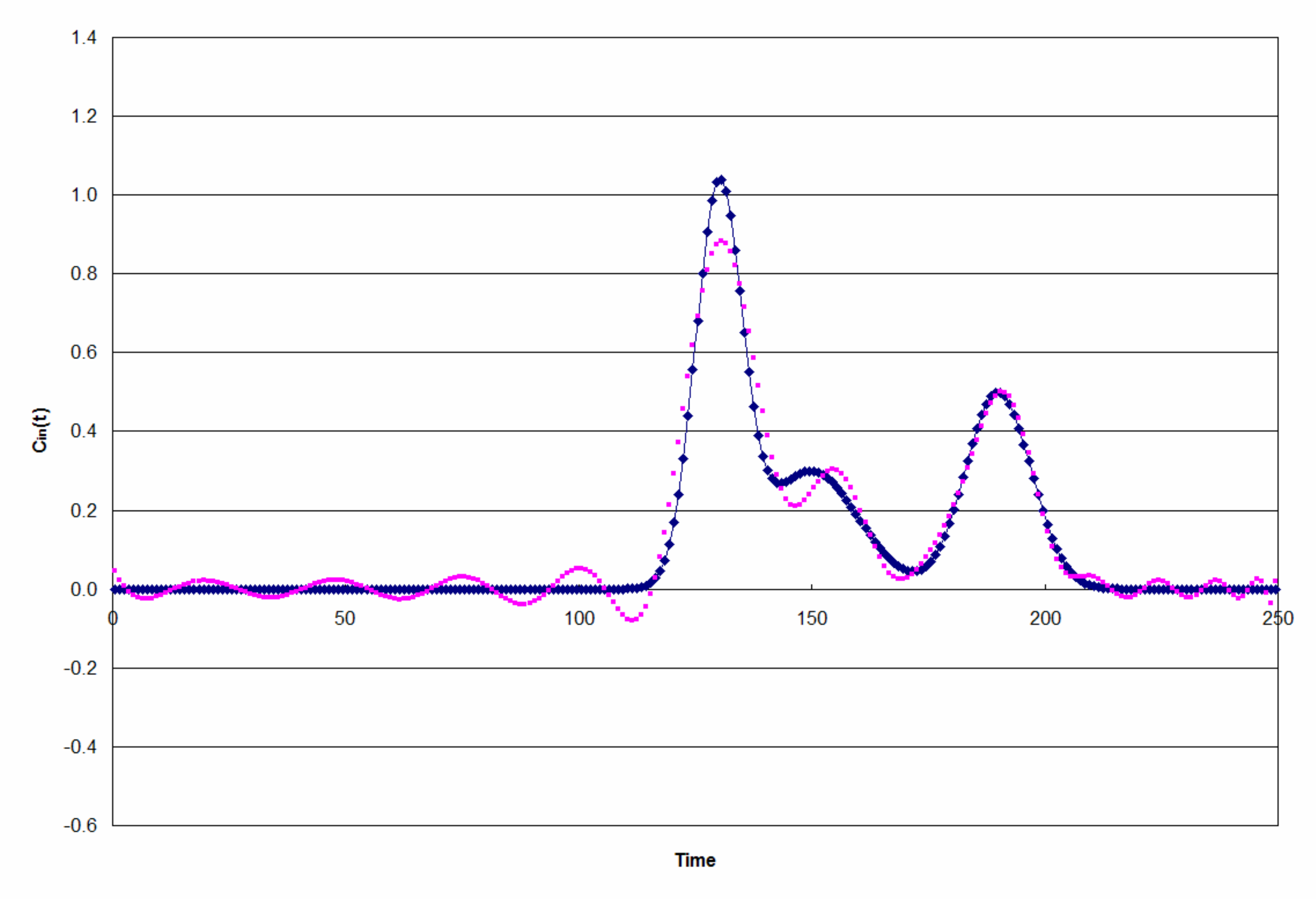




US Army Corps of Engineers

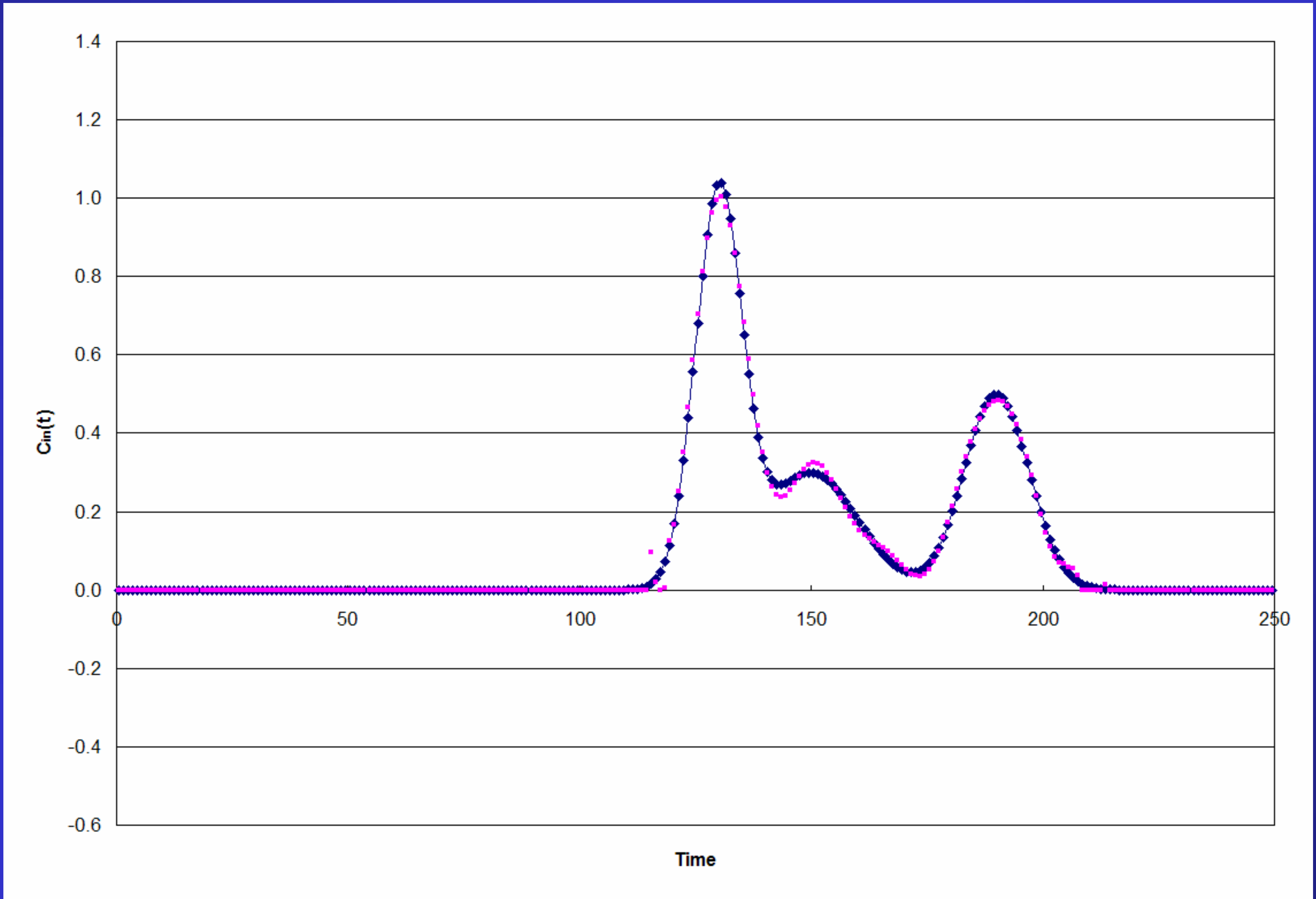
Skaggs, T.H., and Z.J. Kabala, Recovering the release history of a groundwater contaminant, *Water Resources Research*, 30(1), 71-79, 1994.

EXAMPLE



US Army Corps of Engineers

EXAMPLE

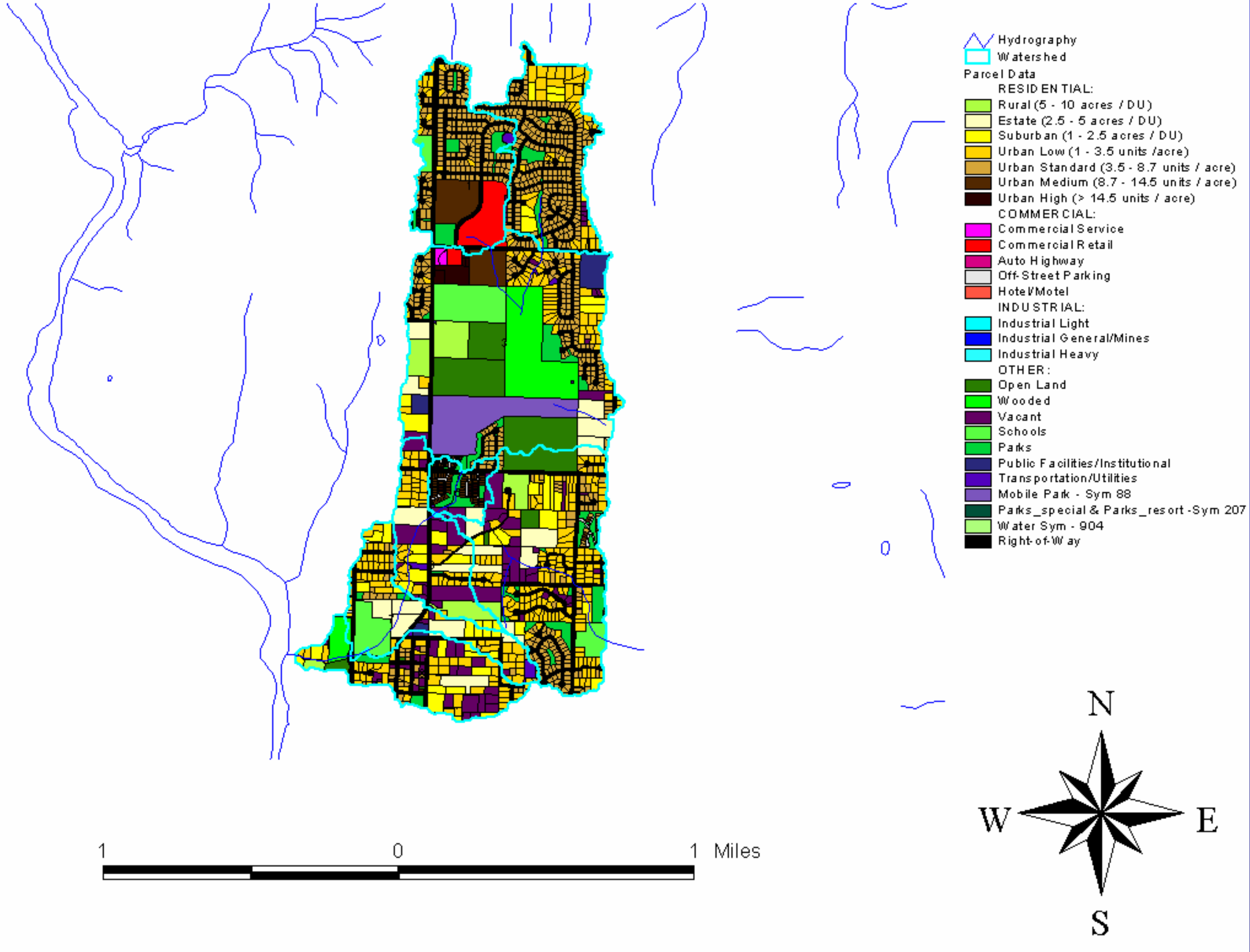


US Army Corps of Engineers

POINTS

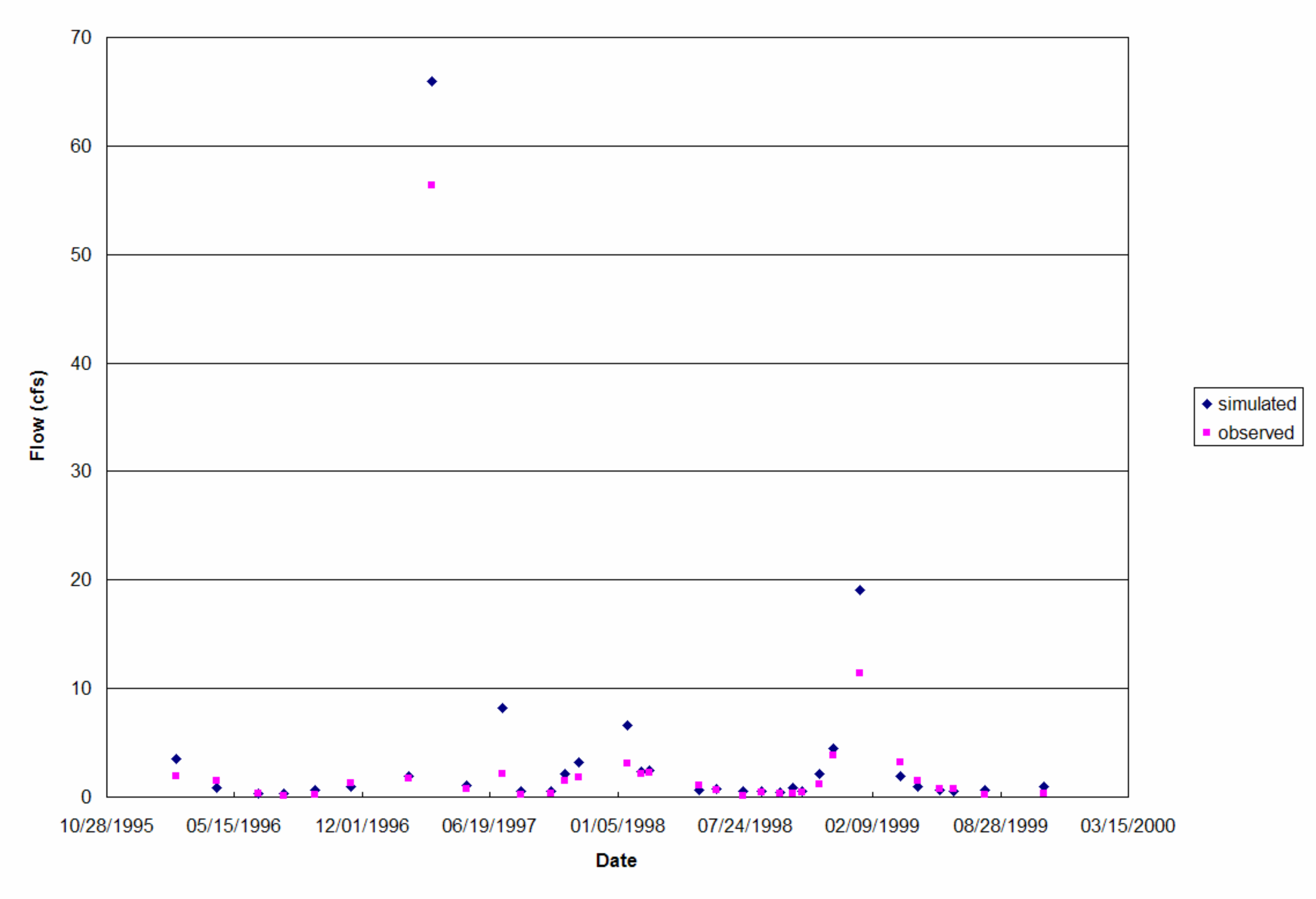
- WITH REGULARIZATION, THERE IS A TRADE OFF BETWEEN FITTING THE DATA IN EXCHANGE FOR SOLUTION STABILITY
- WITH TSVD, NO ABILITY TO INSIST ON THE OBSERVANCE OF SPECIFIED PARAMETER RELATIONSHIPS IN ATTAINING STABILITY

EXAMPLE



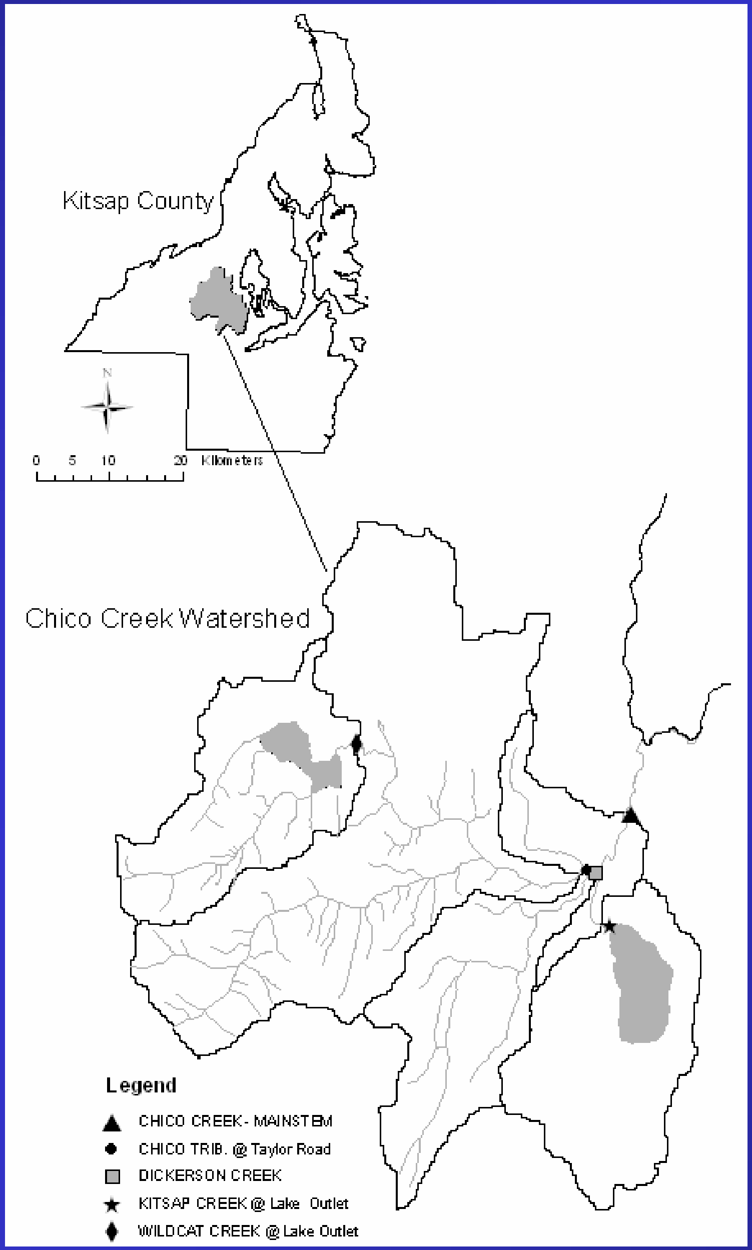
Hydrography
Watershed
Parcel Data
RESIDENTIAL:
Rural (5 - 10 acres / DU)
Estate (2.5 - 5 acres / DU)
Suburban (1 - 2.5 acres / DU)
Urban Low (1 - 3.5 units /acre)
Urban Standard (3.5 - 8.7 units / acre)
Urban Medium (8.7 - 14.5 units / acre)
Urban High (> 14.5 units / acre)
COMMERCIAL:
Commercial Service
Commercial Retail
Auto Highway
Off-Street Parking
Hotel/Motel
INDUSTRIAL:
Industrial Light
Industrial General/Mines
Industrial Heavy
OTHER:
Open Land
Wooded
Vacant
Schools
Parks
Public Facilities/Institutional
Transportation/Utilities
Mobile Park - Sym 88
Parks_special & Parks_resort -Sym 207
Water Sym - 904
Right-of-Way
1
0
1 Miles
N
W
E
S

EXAMPLE



US Army Corps of Engineers

EXAMPLE



Doherty, J., Skahill, B., (2005). "An Advanced Regularization Methodology for Use in Watershed Model Calibration" Submitted for publication in Journal of Hydrology.

EXAMPLE

Streamflow Gaging Station	Adaptive regularization	Hardwired parameter equality
Kitsap Creek	0.768	0.336
Wildcat Creek	0.918	0.879
Chico Creek (Taylor Road)	0.888	0.675
Dickerson Creek	0.936	0.879
Chico Creek (mainstream)	0.952	0.916
All gaging stations	0.917	0.846

Nash-Sutcliffe coefficients for log of daily flows based on simultaneous calibration through regularized inversion (column 2) and simultaneous calibration with hardwired parameter equality (column 3)

EXAMPLE

Parameter	Kitsap Ck.	Wildcat Ck.	Chico Ck. (Taylor Rd.)	Dickerson Ck.	Chico Ck. (mainstream)	Wildcat Creek only
AGWETP	2.08E-03	1.75E-03	1.55E-03	1.83E-03	1.92E-03	1.15E-03
AGWRC	0.985	0.982	0.964	0.984	0.975	0.981
DEEPFR	9.00E-03	7.37E-03	1.26E-02	7.53E-03	1.18E-02	0.18
INFILT	0.36	0.11	.091	0.12	0.19	0.093
INTFW	1.42	2.53	1.64	2.95	1.56	1.88
IRC	0.81	0.63	0.71	0.72	0.73	0.67
LZETP	0.28	0.41	0.57	0.12	0.59	0.36
LZSN	17.8	19.7	33.1	20.5	18.2	14.4
UZSN	3.94	3.45	5.08	4.75	2.82	3.26

Columns 2 – 6: Estimated values for subwatershed model parameters for attainment of best fit at all Chico Creek subwatershed streamflow gaging stations. Regularization was employed in the parameter estimation process. Column 7: calibration of the Wildcat Creek subwatershed model alone.

SUMMARY

- REGULARIZATION IS A MEASURE OR ADDITIONAL CONSTRAINT THAT IS TAKEN TO ENSURE THAT A STABLE SOLUTION IS OBTAINED TO AN OTHERWISE ILL-POSED INVERSE PROBLEM
- WITH REGULARIZATION, THERE IS A TRADE OFF BETWEEN FITTING THE DATA IN EXCHANGE FOR SOLUTION STABILITY
- REGULARIZATION ELIMINATES THE NEED FOR “PREEMPTIVE PARSIMONIZING” AHEAD OF THE CALIBRATION PROCESS
- THE RESULT IS A STABLE PROCESS THAT ALLOWS MAXIMUM RECEPTIVITY OF PARAMETERS TO BOTH “HARD INFORMATION” PROVIDED BY THE MEASUREMENT DATASET AND “SOFT DATA” EMBODIED IN A MODELER’S UNDERESTANDING OF THE AREA, ENCAPSULATED IN THE SET OF REGULARIZATION CONSTRAINTS

USE OF REGULARIZATION AS A METHOD FOR WATERSHED MODEL CALIBRATION

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August 2005

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Using GIS and HEC-RAS for Flood Emergency Plans

Flood Emergency Plan (FEP)

- The purpose of an FEP is to simulate the probable effects of a dam failure to ensure that loss of life is minimized through appropriate advance warning.
- FEPs are products for groups and government agencies that are responsible for the protection of citizens in case a dam failure were to occur.

Dambreak Analysis Steps

- Step 1: Determine probable extent of flood wave
- Step 2: Choose dam failure scenarios (PMF with and without dam failure, Sunnyday Failure)
- Step 3: Find or create the failure event conditions (pool level, hydrographs, etc.)
- Step 4: Determine dam failure mode and the time it takes for dam to fail (based on dam dimensions and composition)

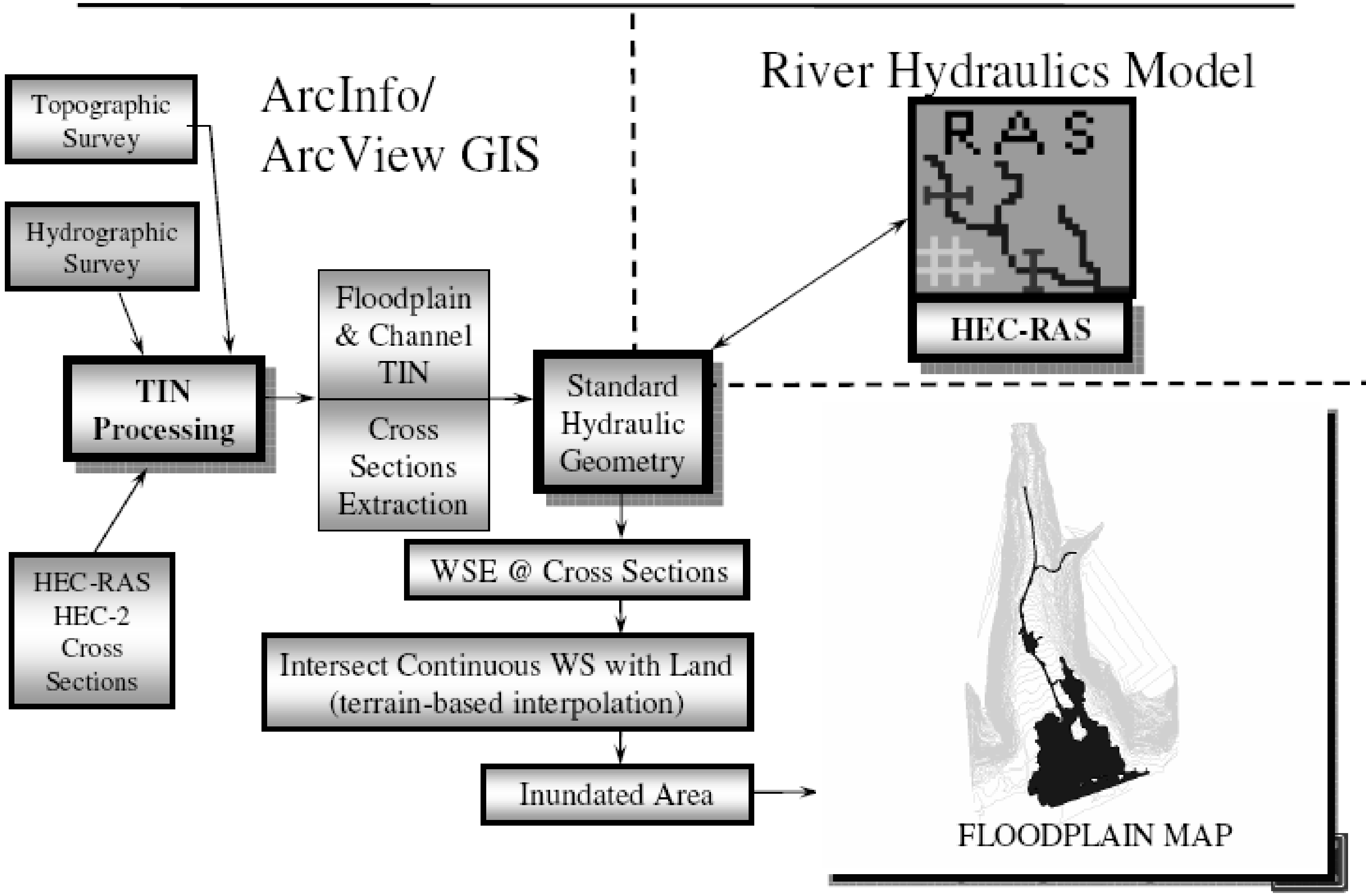
Dambreak Analysis Steps

- Step 5: Obtain terrain data of all areas affected by the failure of the dam.
- Step 6: Simulate the flood wave that would be released downstream if the dam were to fail
- Step 7: Create maps that show the areas flooded if the dam were to break, and the time that the wave will arrive.
- Step 8: Have an emergency plan in place should the threat of a dam failure ever arise.

Required Software

- ArcView (Geographic Information System)
- Geo-RAS extension for ArcView
- Spatial and 3-D Analyst extensions
- HEC-Ras (3.1.3 latest edition)

HEC-GeoRAS

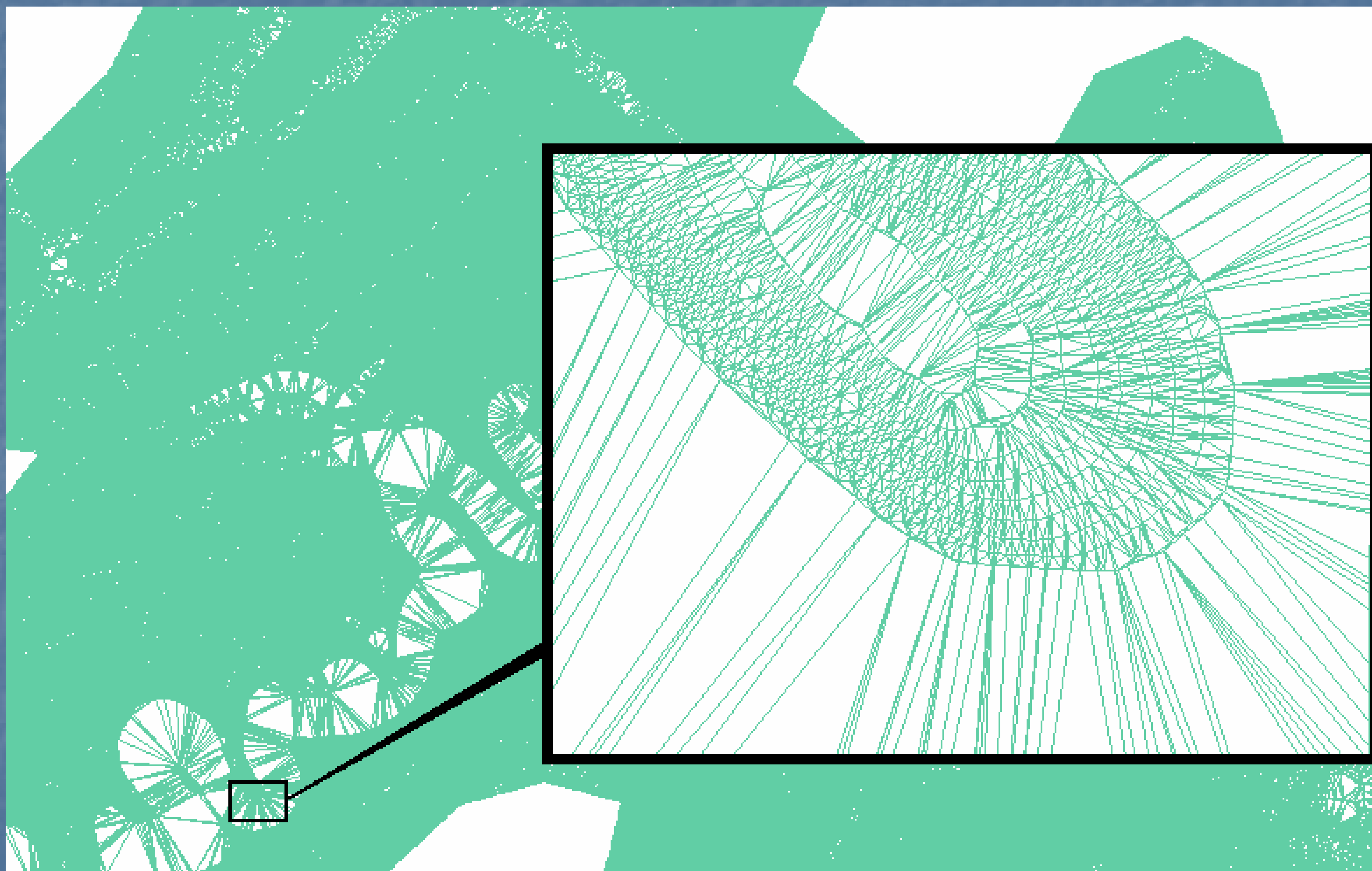


ArcInfo/
ArcView GIS
River Hydraulics Model
Topographic Survey
Hydrographic Survey
TIN Processing
HEC-RAS HEC-2 Cross Sections
Floodplain & Channel TIN
Cross Sections Extraction
Standard Hydraulic Geometry
RAS
HEC-RAS
WSE @ Cross Sections
Intersect Continuous WS with Land (terrain-based interpolation)
Inundated Area
FLOODPLAIN MAP

Terrain Data

- 10 meter Digital Elevation Models (based on USGS Quads, free download)
- Bathimetric survey data for Reservoir
- Gage information for channel shape and slope
- Bridges from state Department of Transportation
- Dam information was in-house

TIN Generation



Army Corp Resources

- Water Control Section: Flood hydrographs, gage information and gate operation
- Geotechnical Section: Breach size and formation time
- Bathimetric Surveys
- Dam plans

Raystown Project

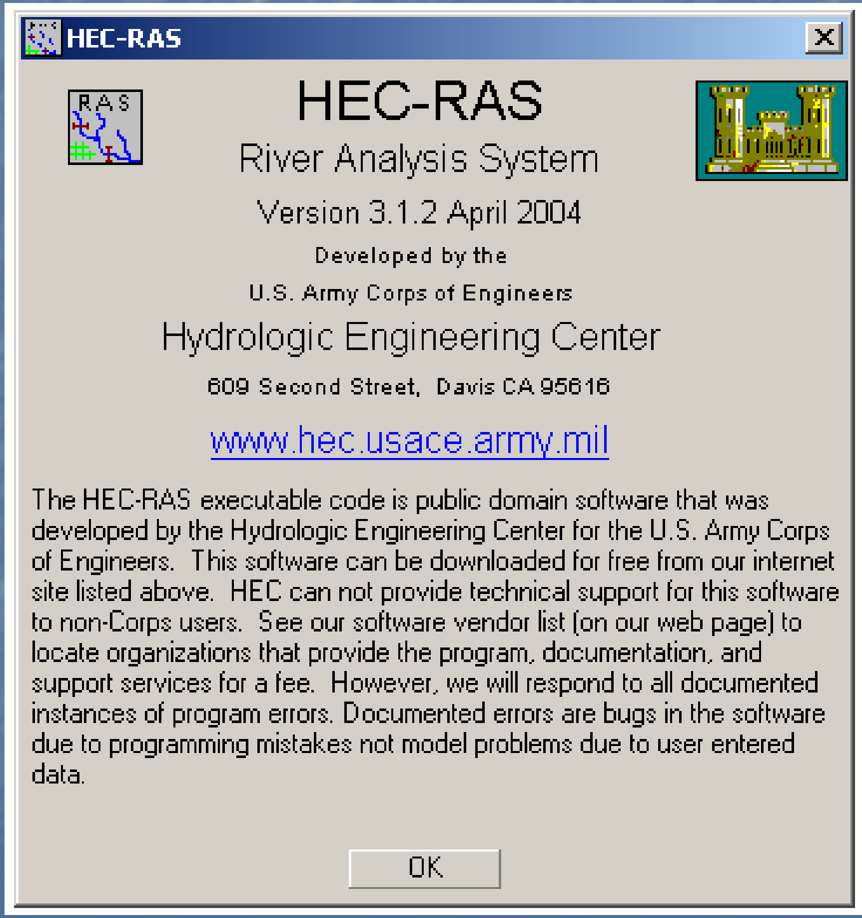
- Nearly 230 feet high
- Maximum storage of 871,000 acre feet
- 1.8 million cfs outflow during dambreak
- Flood extent of nearly 120 miles downstream

HEC Unsteady Flow Advantages

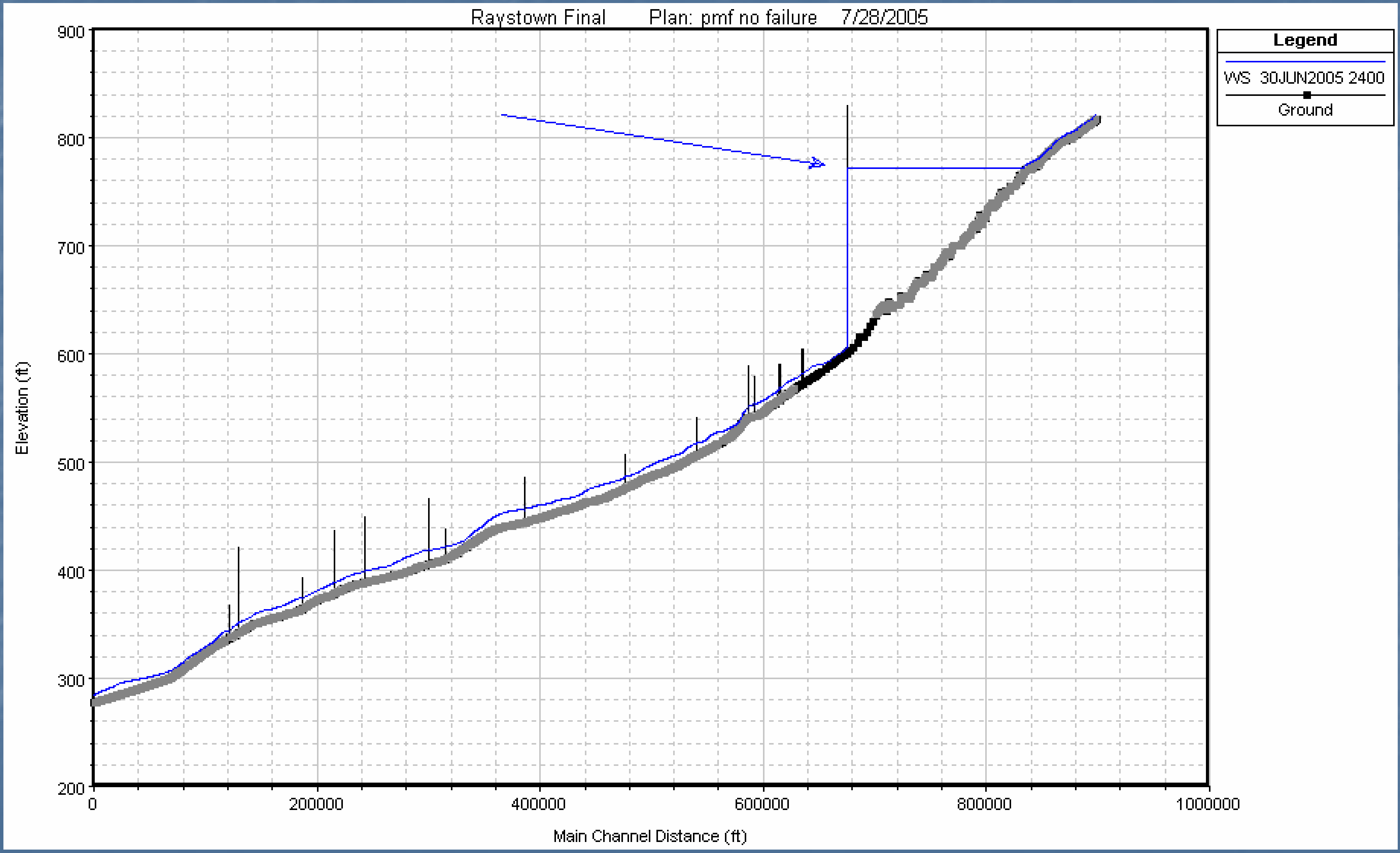
- Dynamic modeling that allows hydrographs to be modeled
- Can model tidal reaches, storage area attenuation, negative flow, multiple channels
- Dam and levee failures

HEC-River Analysis System

- Simple interface
- Multiple graphical aides
- Steady and Unsteady applications
- GeoRAS – Arcview



Breach Animation



Unsteady Flow Troubleshooting

- Geometry problems
  - HTAB parameters
  - Sharp slope changes
  - Mixed and supercritical flow
  - Dams or bridges modeled incorrectly
  - Manning's n values change abruptly
  - Cross-sections spaced incorrectly
  - Large effective flow changes

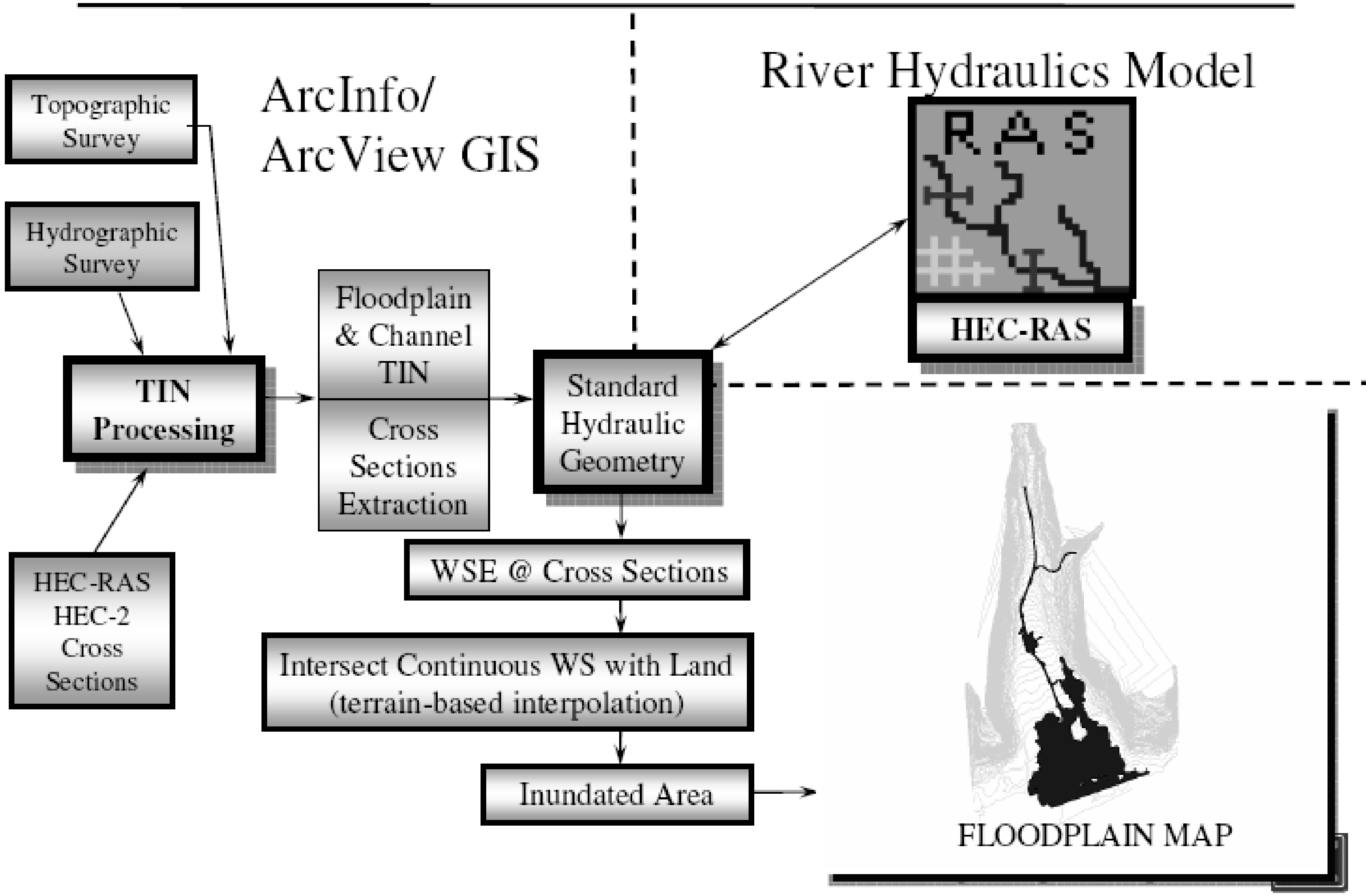
Unsteady Flow Troubleshooting

- Flow Hydrographs
  - Initial flows don’t add up
  - Not enough flow in channel
  - Hydrographs don’t match

Unsteady Flow Troubleshooting

- Calculation Options
  - Computation Interval too small
  - Needs warm up time steps
  - Not enough calculation intervals

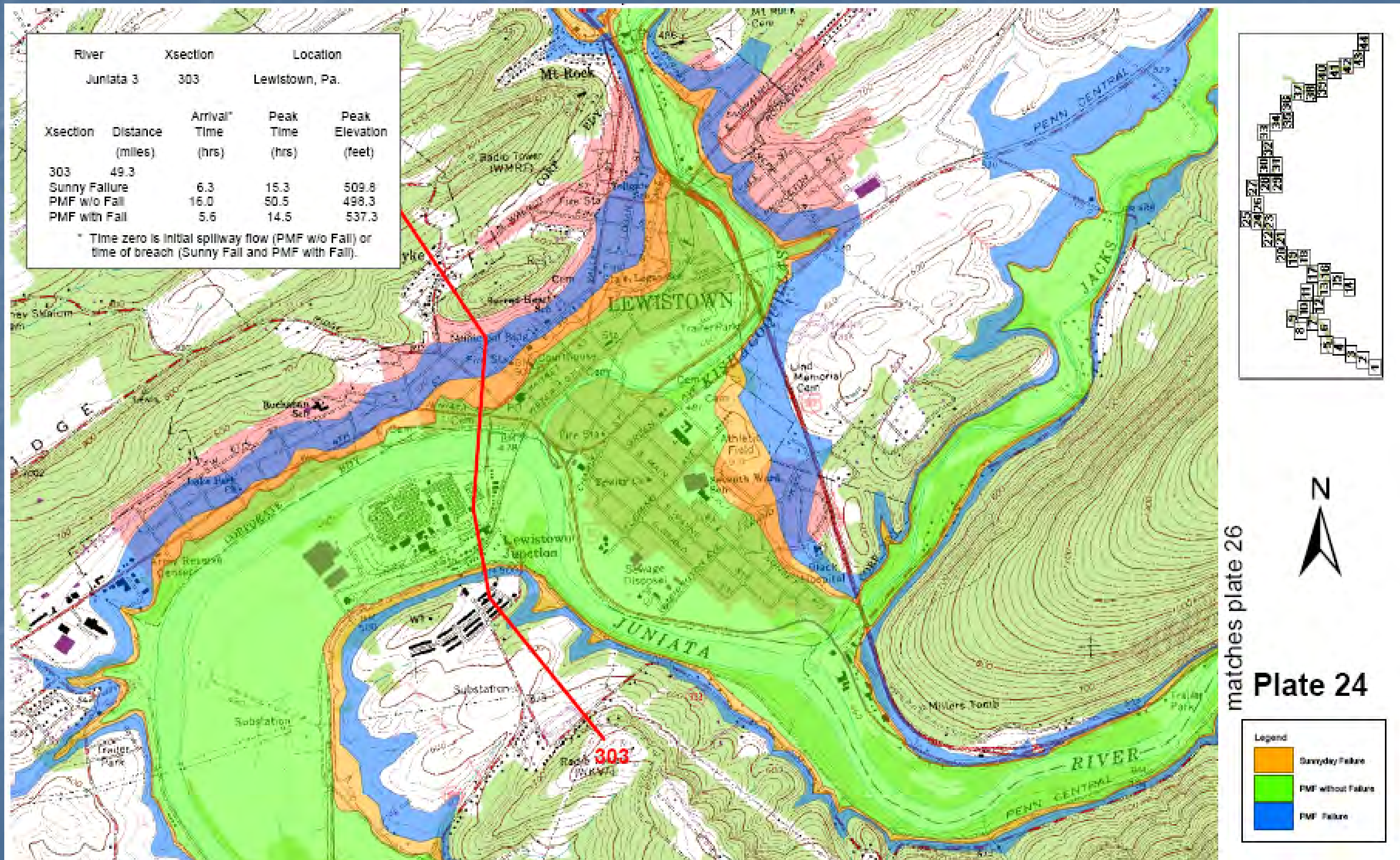
HEC-GeoRAS


ArcInfo/
ArcView GIS
River Hydraulics Model
Topographic Survey
Hydrographic Survey
TIN Processing
HEC-RAS HEC-2 Cross Sections
Floodplain & Channel TIN
Cross Sections Extraction
Standard Hydraulic Geometry
RAS
HEC-RAS
WSE @ Cross Sections
Intersect Continuous WS with Land (terrain-based interpolation)
Inundated Area
FLOODPLAIN MAP

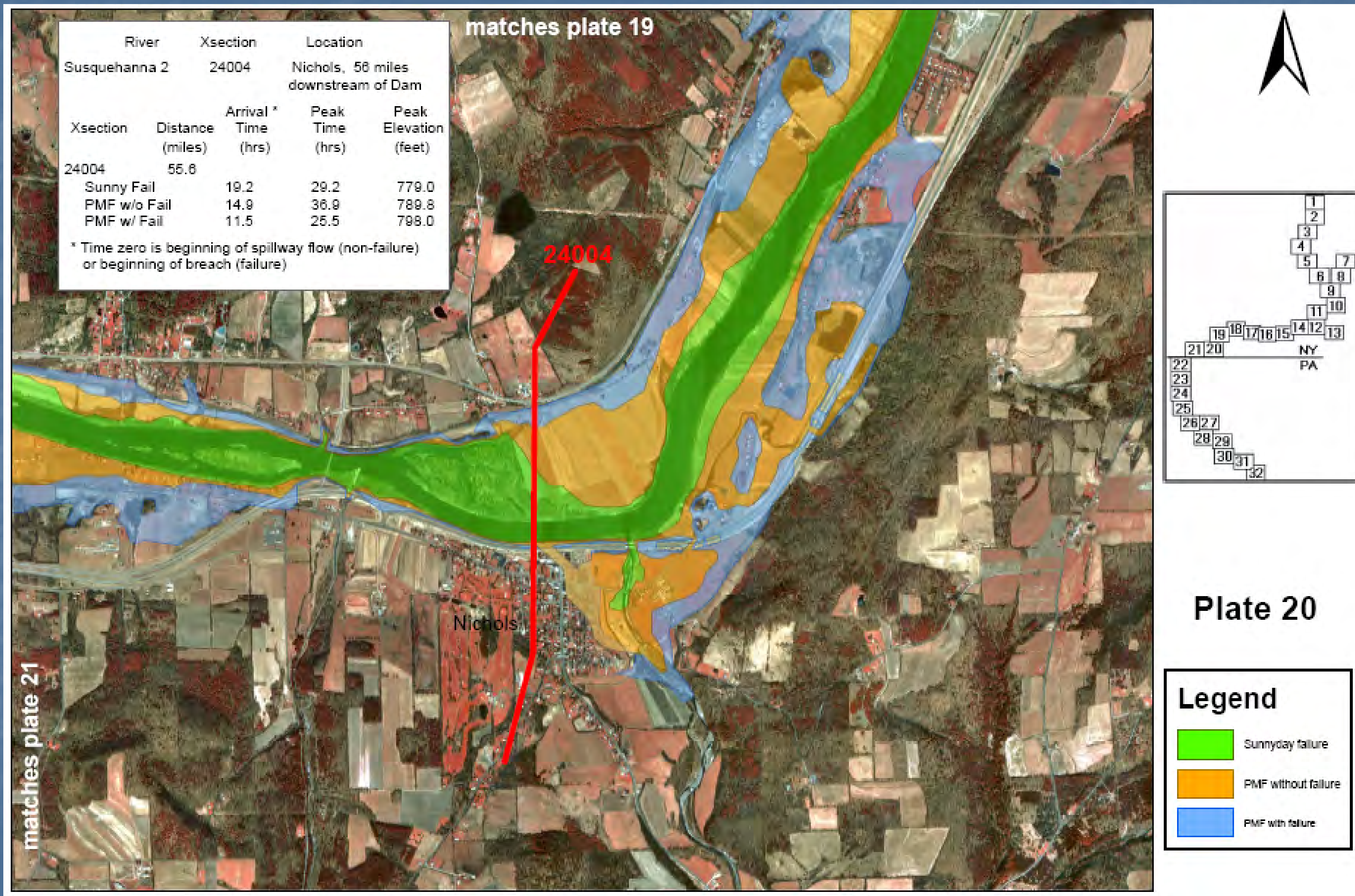
GIS Advantages

- River distances, shape, and characteristics such as bank stations are automatically imported into the Geometry editor from GIS
- Flood extents are automatically generated using GeoRAS
- Flood inundation is easily combined with mapping to clearly represent flood limits

Final Product



Final Product



Questions?

NDIA – 2005 Tri-Service Infrastructure System Conference & Exhibition
The America's Center
St. Louis, MO
Event #5150

Wednesday, August 3rd, 2005
H&H Community of Practice
Track 4 Session 4D (4:30 – 5:00)

High Resolution Visualizations of Multibeam Data of the Lower Mississippi River

US Army Corps of Engineers – New Orleans District

Tom Tobin
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New Orleans District

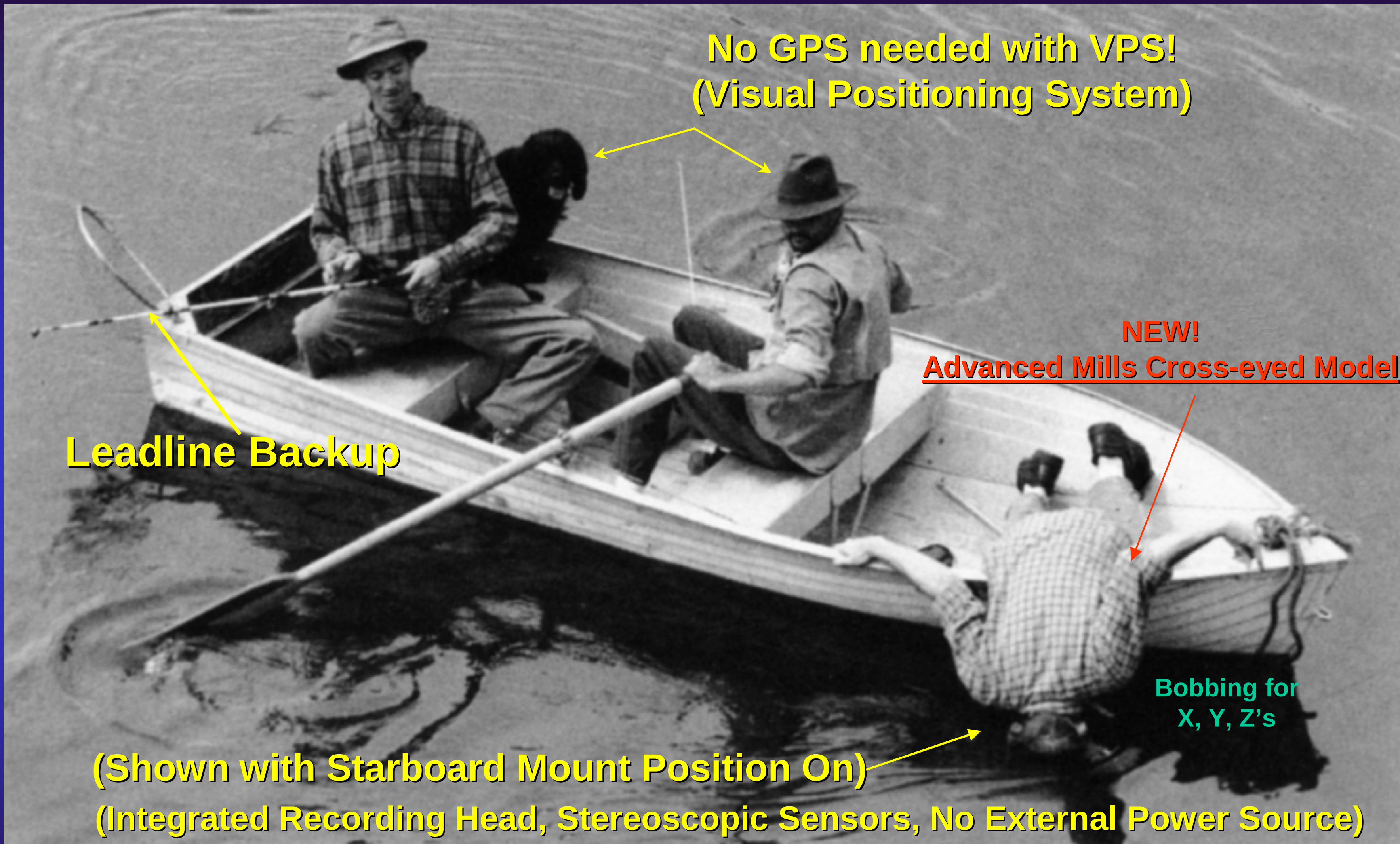
High Resolution Visualizations of Multibeam Data of the Lower Mississippi River

Tom Tobin & Heath Jones
August 3rd, 2005

Typical Equipment on Survey Boat Performing River Engineering Surveys on the Mississippi and Inland Rivers

- **SeaBat 8101** - 240 kHz Multibeam Bathymetric and Sidescan Imaging Sonar (**Reson, Inc**.)
- **SeaBat 8125 -** 455kHz Multibeam Bathymetric and Sidescan Imaging Sonar (**Reson, Inc**.)
- **HYPACK** and **HYSWEEP** software (HYPACK, Inc.)
- **P**osition **O**rientation **S**ystem with a Trimble Differential and RTK GPS aided Inertial Block to collect Position along with Heave, Pitch, Roll and Heading Corrections (TSS-UK Ltd.)
- **A**coustic **D**oppler **C**urrent **P**rofiler - 600 kHz and 1200 kHz (RD Instruments)
- **WinRiver** Current Profile Acquisition Software (RD Instruments)
- Model **448** - 210 kHz Single Beam Echo Sounder (Innerspace Technology)
- Model **850** - 210 kHz Single Beam Echo Sounder with Portable Transducer (ROSS Laboratories)
- **CTD – 1820** Sound Velocity Probe with Salinity and Temperature Recorder (Marimatech)
- **DT 5000** 120 kHz Dual Beam System for Locating Fish or Biomass (BioSonics)
- **DT 4000** 200 kHz Dual Beam System for Identifying Bottom Classification (BioSonics)
- **RoxAnn** Seabed Identification Sonar to Identify Bed Material Types (Stenmar Sonavision)
- **Data Collection Computer** - 3.06 GHz CPU Processor, 120 Gb Harddrive, 1 Gb RAM, Quad Monitor Card, (10) Hi-Speed Com ports, (2) Ethernet (NIC) ports, (1) Floppy Drive, (1) 250 Mb ZIP Drive, (1) CD ROM Drive, (1) CD-RW and DVD Drive (Dell)

Variable Position Multibeam



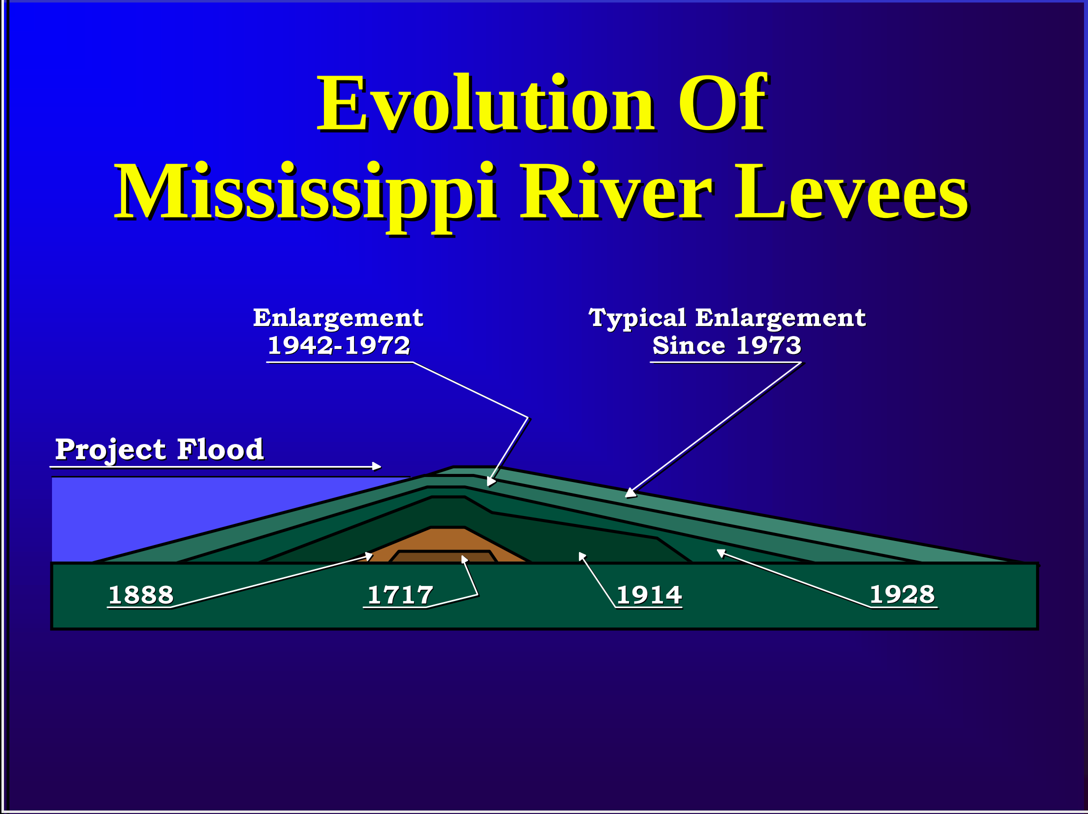
Note: Recording Head can be adjusted for Forward Sensing Capability. To Increase Survey Speed, Shave Head. For Reduced Drag, Bald Headed Model available


Carrollton Wrecks
2003

Mississippi River Levee/Bank Monitoring

• The New Orleans District, partnered with the state levee boards, maintains 486 miles of levee along the Mississippi River (512 miles including the floodwalls).

• 84 existing revetment sites comprise approximately 361 miles of revetment, with 16,000(+) survey ranges.



Maintaining the levee system and providing sufficient draft for navigation requires a continuous river monitoring effort.

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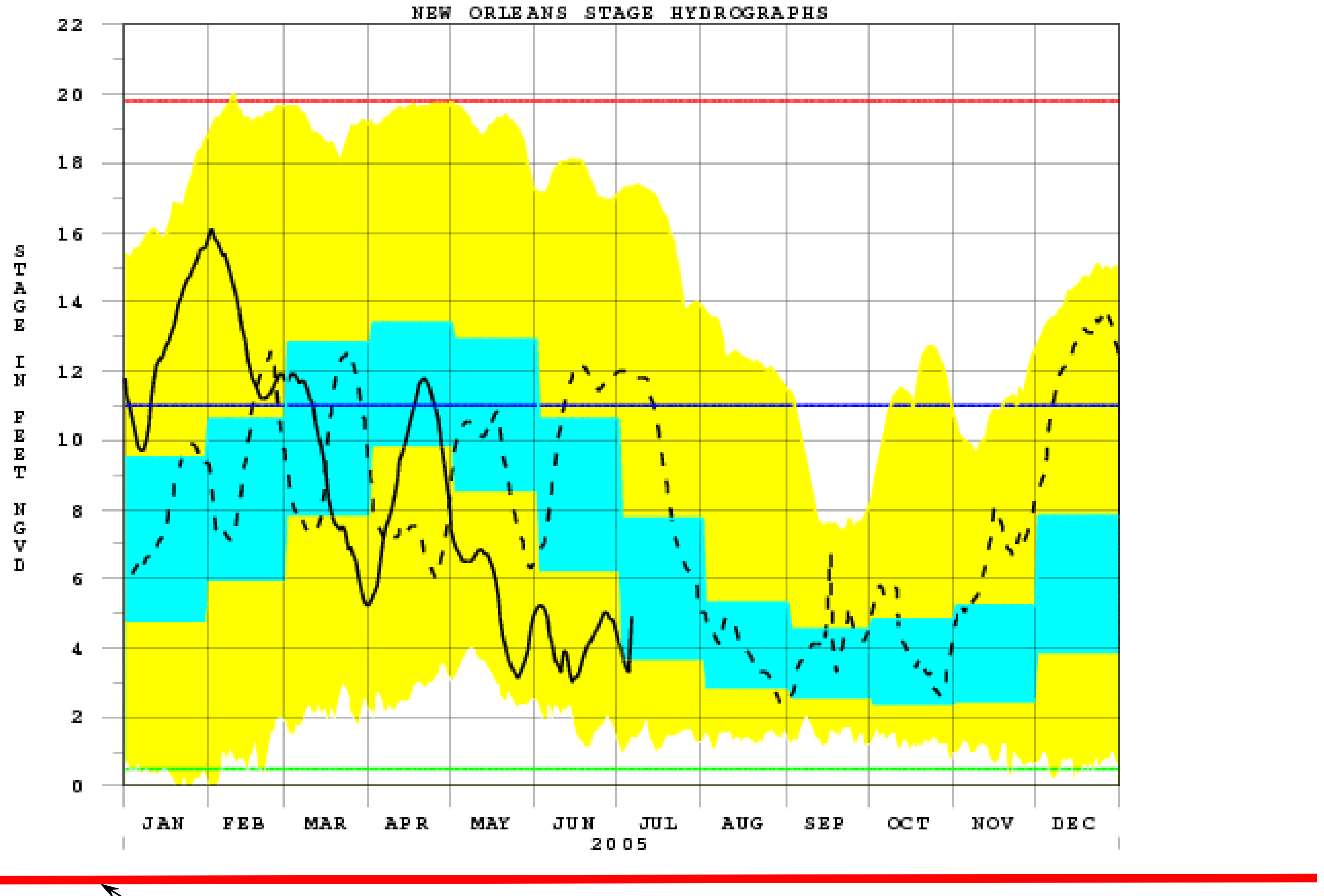


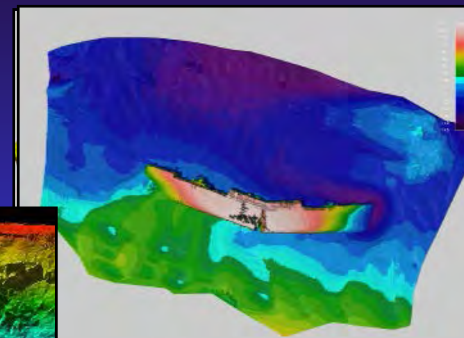
Slab Elevation of my house: -2.8 FT.

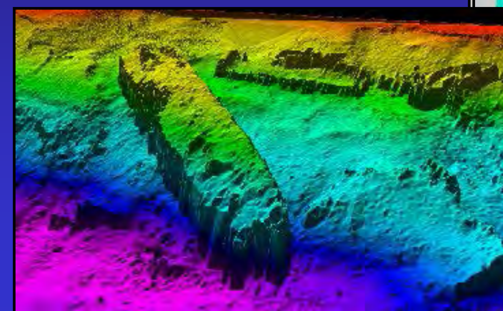
Maintaining Our Levees

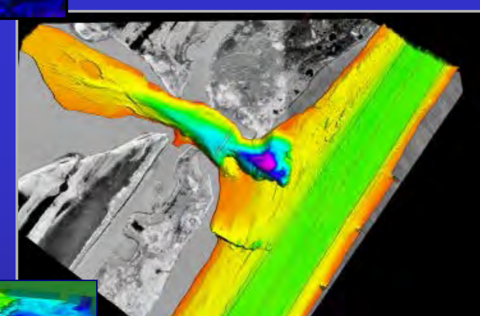
- Bank Stability is one of the keys. In addition to visual levee inspections, we take bathymetric surveys that enable us to see what is going on under the water.
- Approximately 16,000 ranges along 361 miles of revetment at 84 sites on the Mississippi River are surveyed annually.
- Comparing current surveys with previous years surveys shows us where scour/shoaling problems are occurring.
- Traditionally these ranges were surveyed using single beam technology with one point reported every 20 feet along the revetment range line.
- With the advent of multibeam technology, we began using it to survey underneath barges.
- Since 2003, we have been receiving our revetment maintenance survey data in multibeam format.

Benefits of Multibeam Visualizations

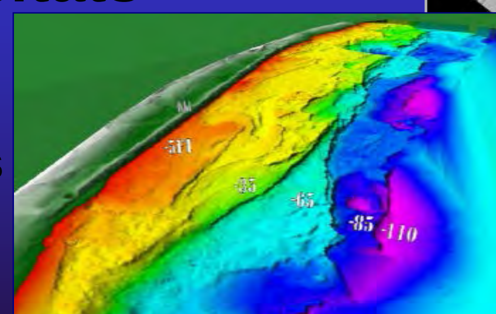
- **Visual aid in locating:**
  - ➢ Submerged obstructions
    - ▪ sunken vessels
    - ▪ pipelines
    - ▪ structures
  - ➢ Scour holes / shoals
  - ➢ Steep banks / hard points
  - ➢ Channel elevations





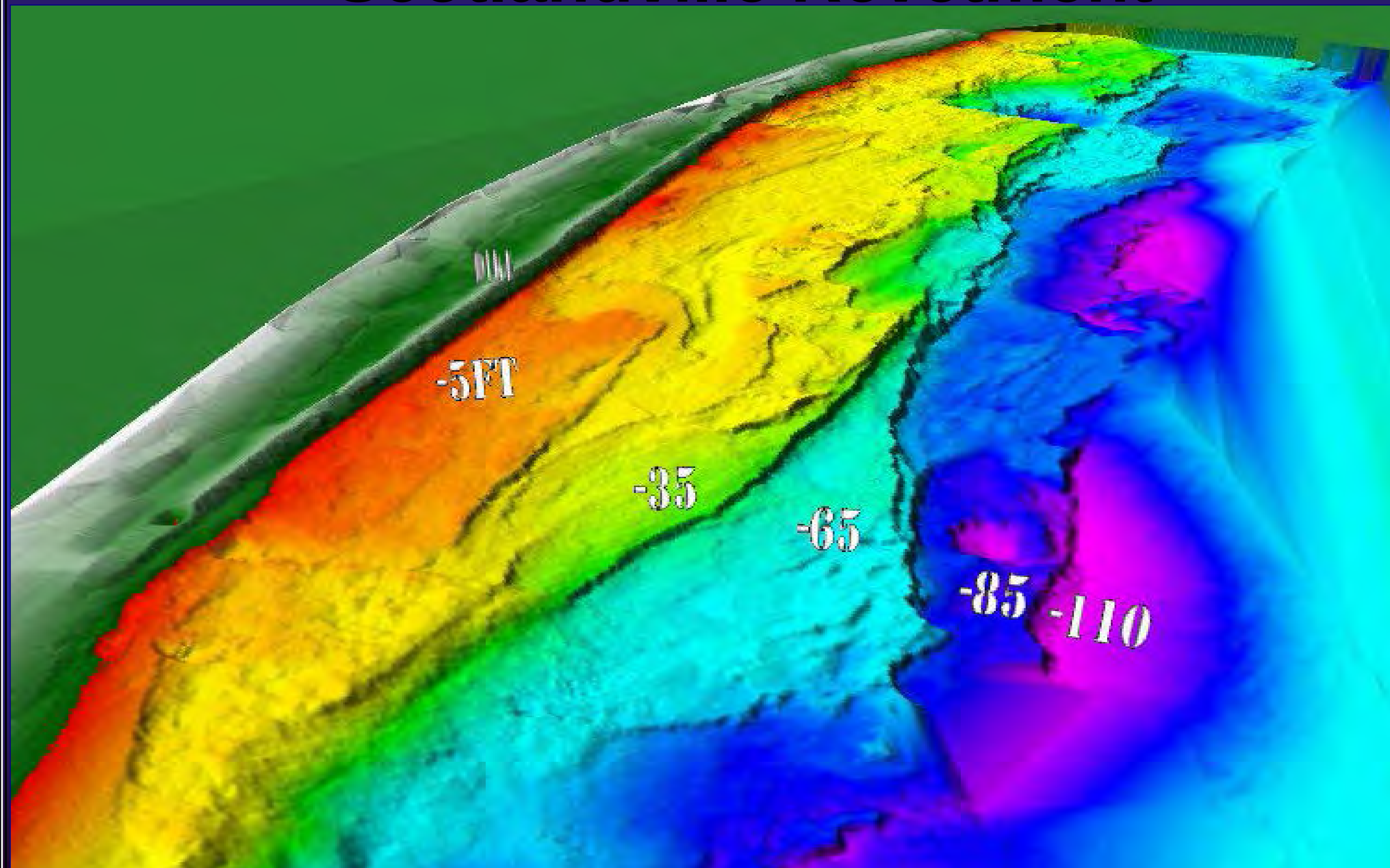


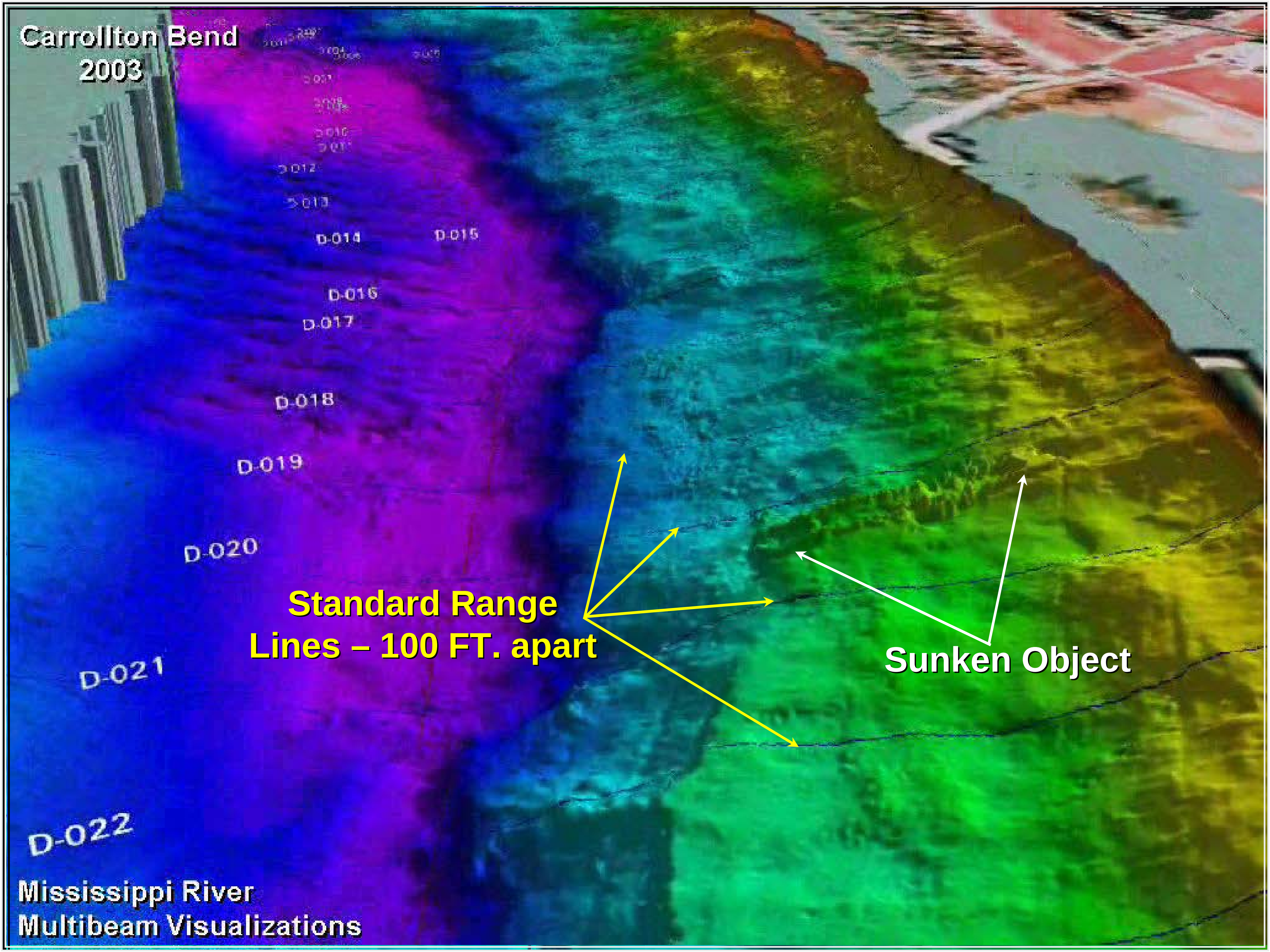
- **Identify Environmental Habitats**
  - ➢ Areas of sediment transport
  - ➢ Sandy bottoms and sandwaves



- **Volumetric computations**
  - ➢ Dredging
  - ➢ Bank degrading

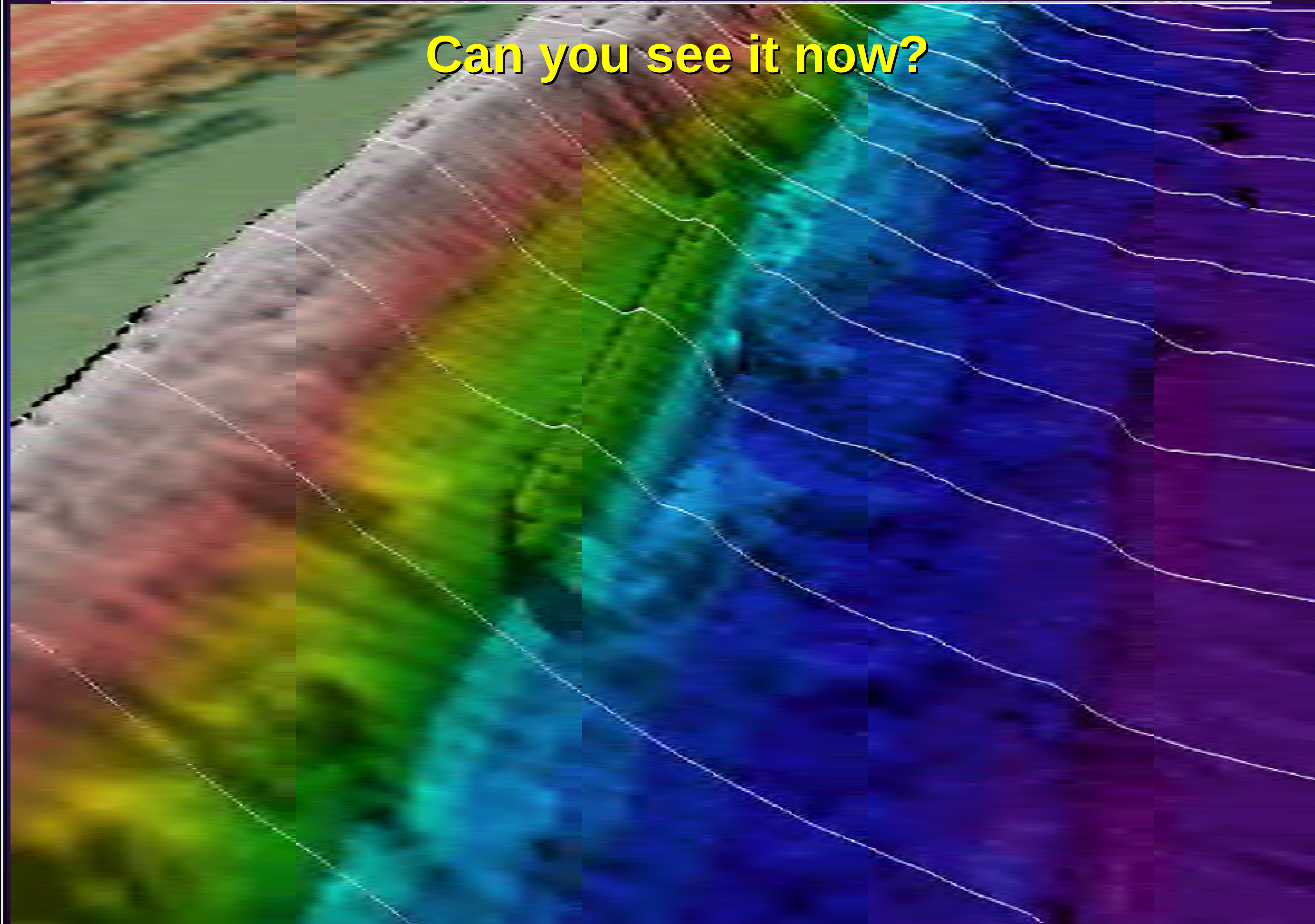
Distinctive Geologic Formations - Scotlandville Revetment



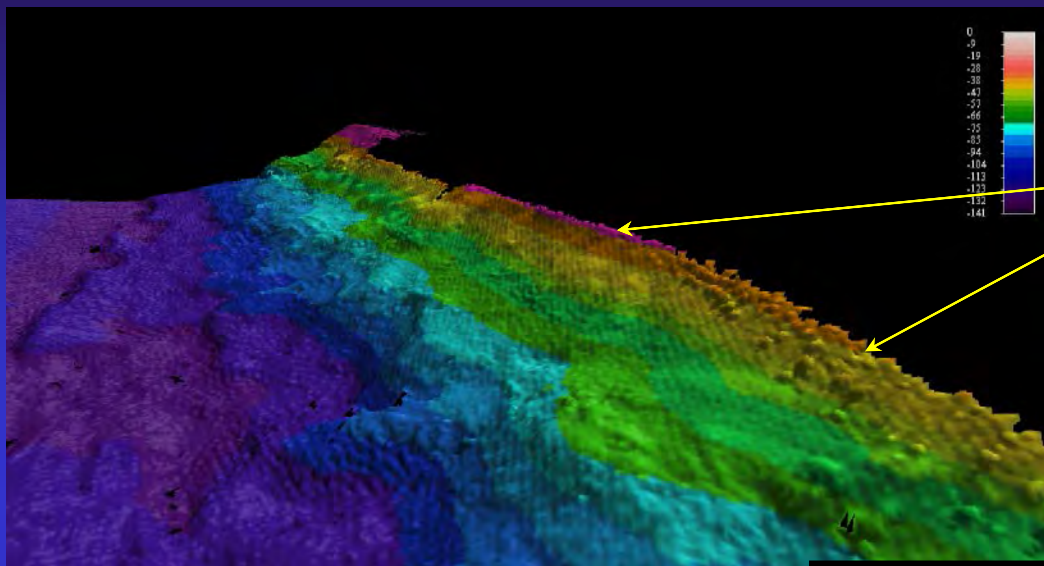


Carrollton Bend
2003
D-014
D-015
D-016
D-017
D-018
D-019
D-020
D-021
D-022
Standard Range
Lines – 100 FT. apart
Sunken Object
Mississippi River
Multibeam Visualizations

Where’s the sunken vessel?

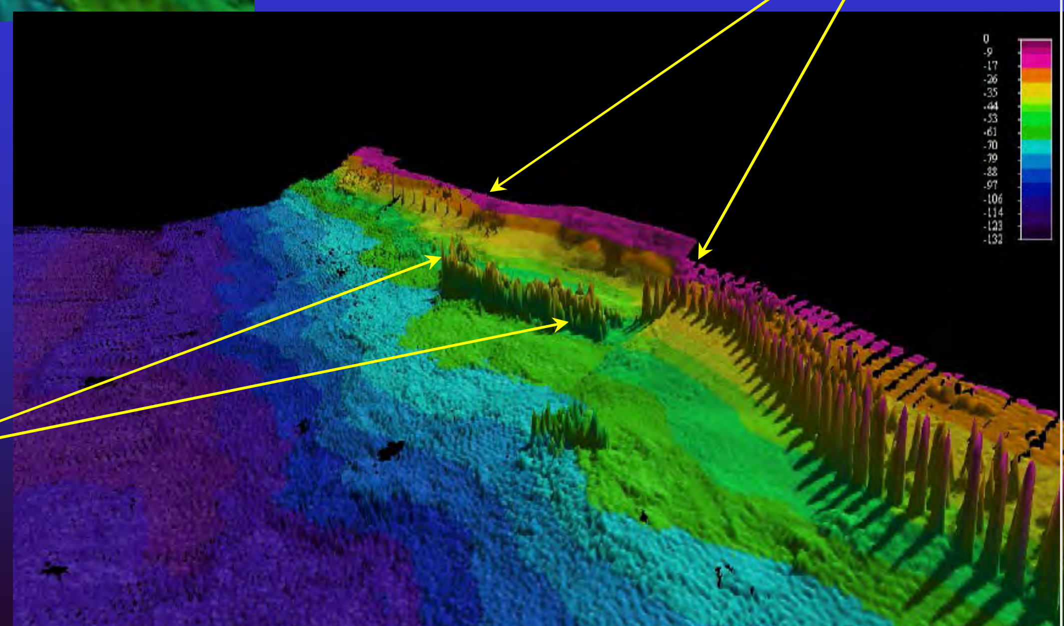


Port Sulphur Bank Failure



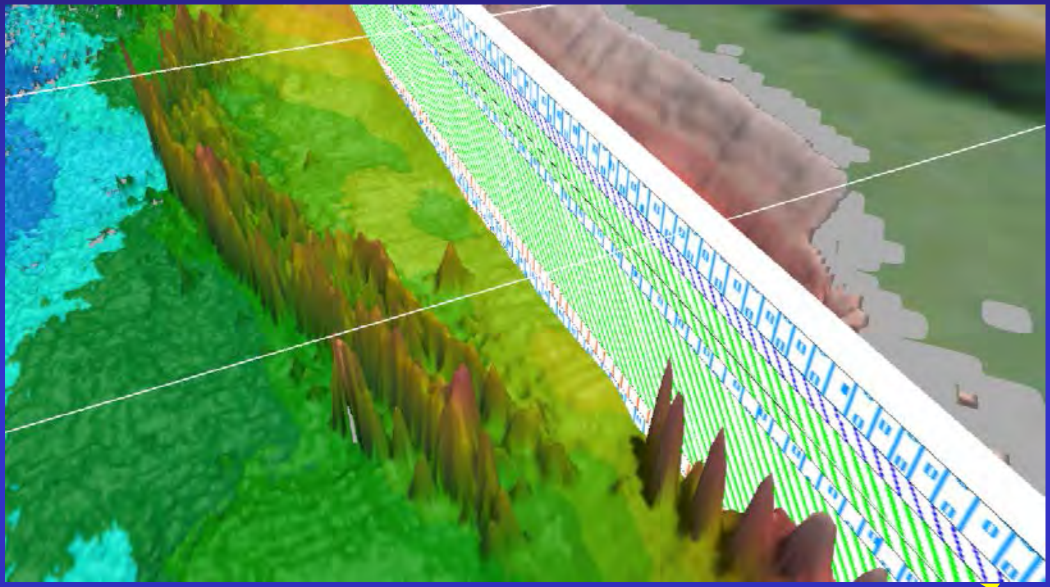
Pre-Failure Bank

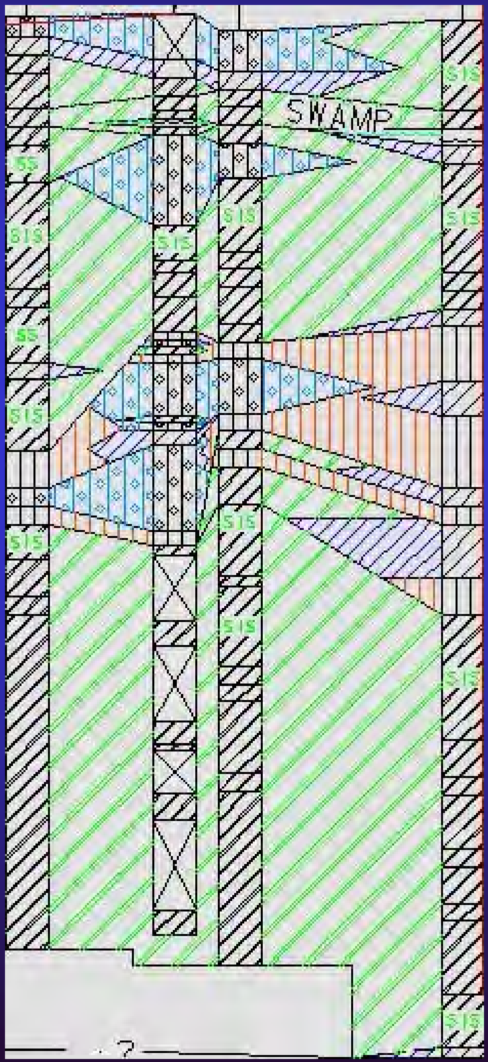
Post-Failure Bank



Piers of Failed Dock

Port Sulphur Bank Failure

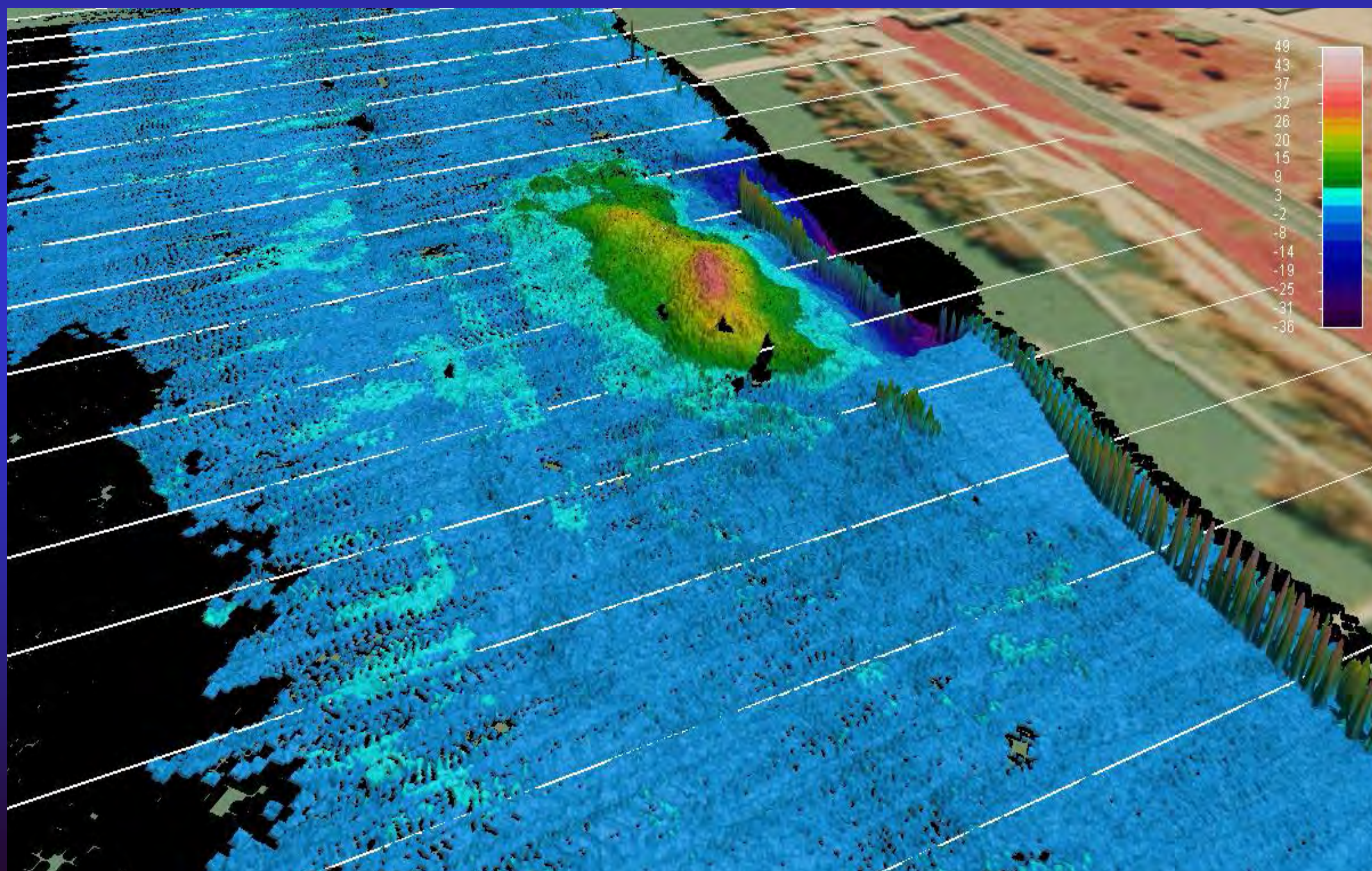




Soil Profile Superimposed

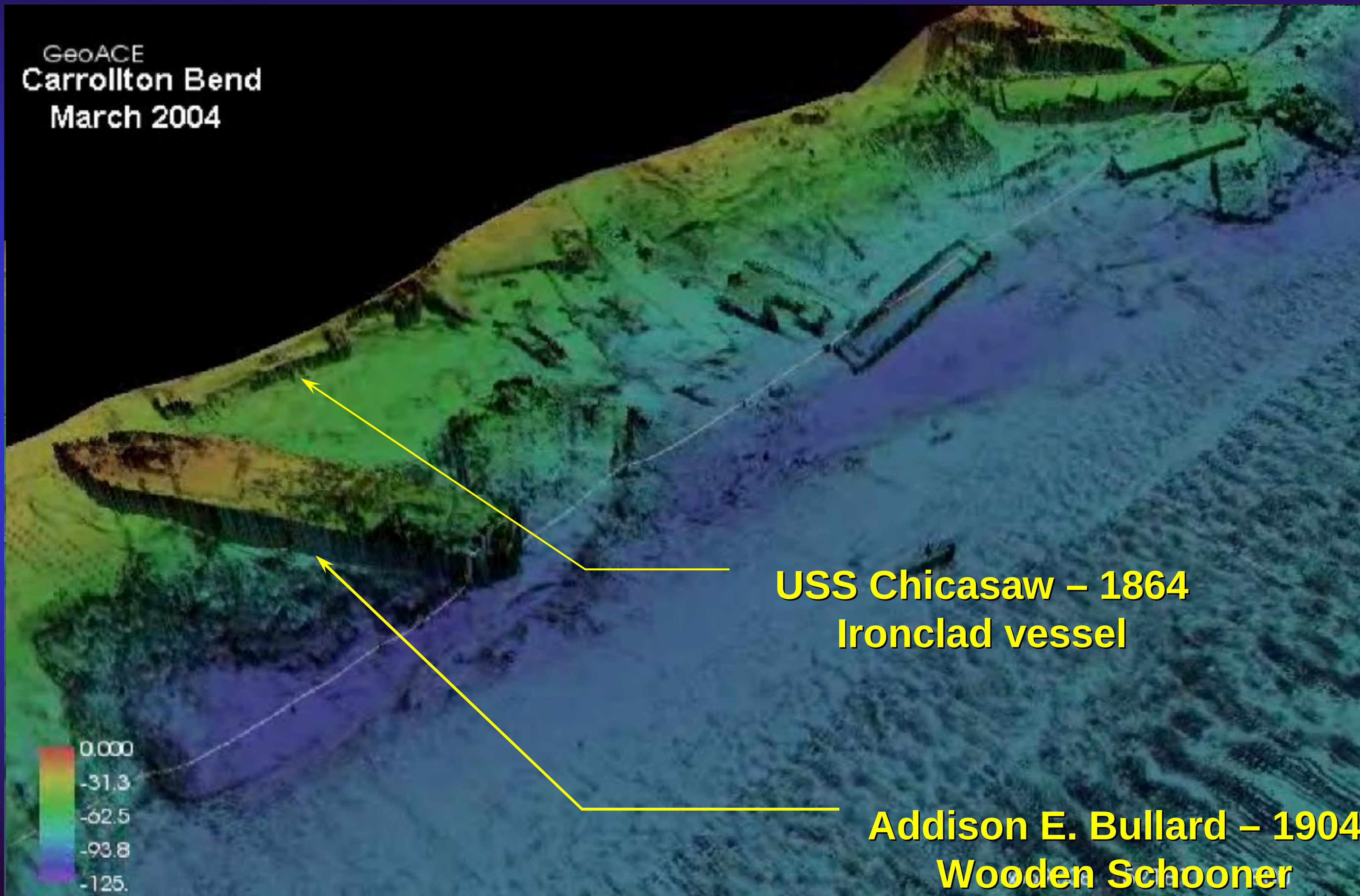
Port Sulphur Bank Failure

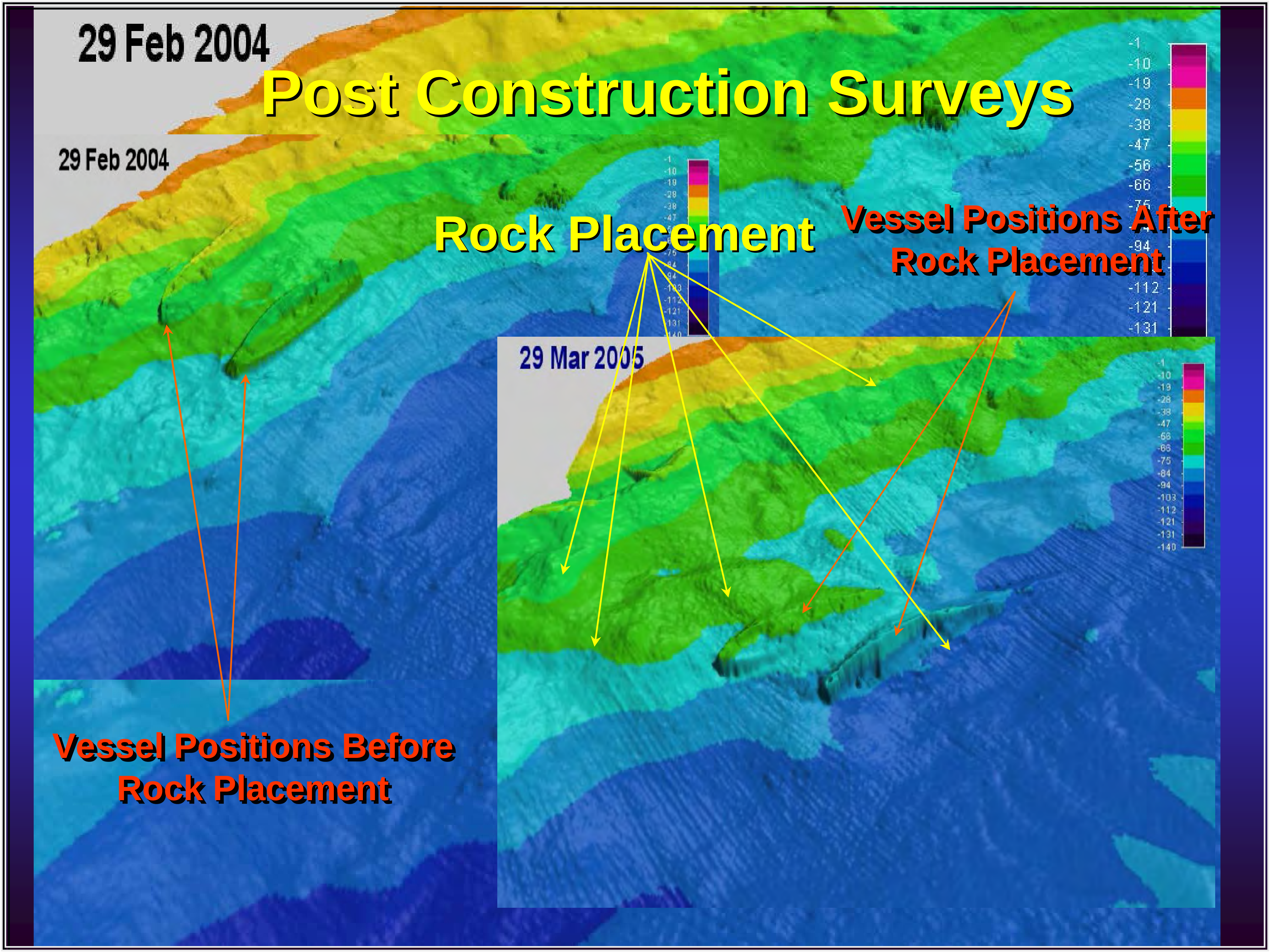
Isopach of Pre/Post Failure Surveys

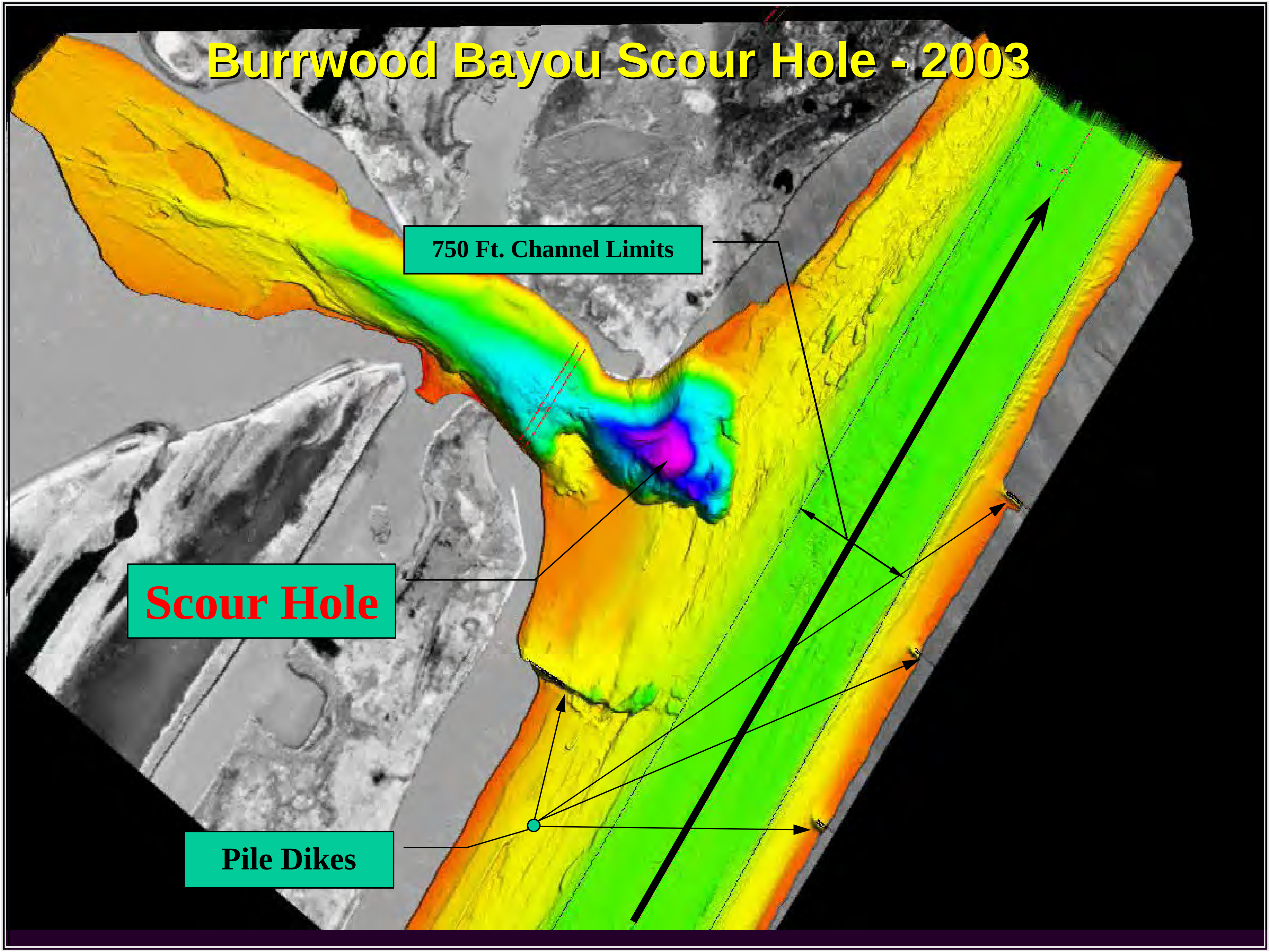



D-0004
D-0003

Carrollton Bend – 2004 RTK Survey




Post Construction Surveys
29 Feb 2004
29 Feb 2004
29 Mar 2005
Rock Placement
Vessel Positions After
Rock Placement
Vessel Positions Before
Rock Placement
-1
-10
-19
-28
-38
-47
-56
-66
-94
-112
-121
-131


Burrwood Bayou Scour Hole - 2003
750 Ft. Channel Limits
Scour Hole
Pile Dikes

Merging LiDAR Data with traditional Survey Data

Problem: No current way to merge LiDAR with other surveying techniques and preserve the topology of the stream.

Solution: Contractor working at MVN developed a program to handle merging operations and much more.

What the program will do.

Collect surveys of varying formats

.EM format

.830 format

Comma seperated xyz format

Make one shape file from up to 500 survey input files.

Shape file has both horizontal and vertical data.

Interpolation

Program will interpolate a channel while preserving the original topology of the stream.

Uses both the stream centerline and survey extents to determine the bounding box of the stream.

HEC-RAS will not preserve the sinuosity of the stream through it’s interpolation routine.

Channel/LiDAR Merger

Program will then merge the newly created channel with existing LiDAR Data

LiDAR can be in varying formats.

- Shapefile
- GeoTiff
- Grid or TIN

Sampling Cross Sections along merged Data Set

- Allows user to sample points along a predefined set of cross section lines.
- Gives user control on how defined each cross section will be.
- Allows differing density of sampled points in the overbanks and channel.
- Outputs sampled lines into a .sdf file which can be directly imported into HEC-RAS

Presenters:
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New Orleans District

http://www.mvn.usace.army.mil

SERVICE TO THE PUBLIC

Navigation

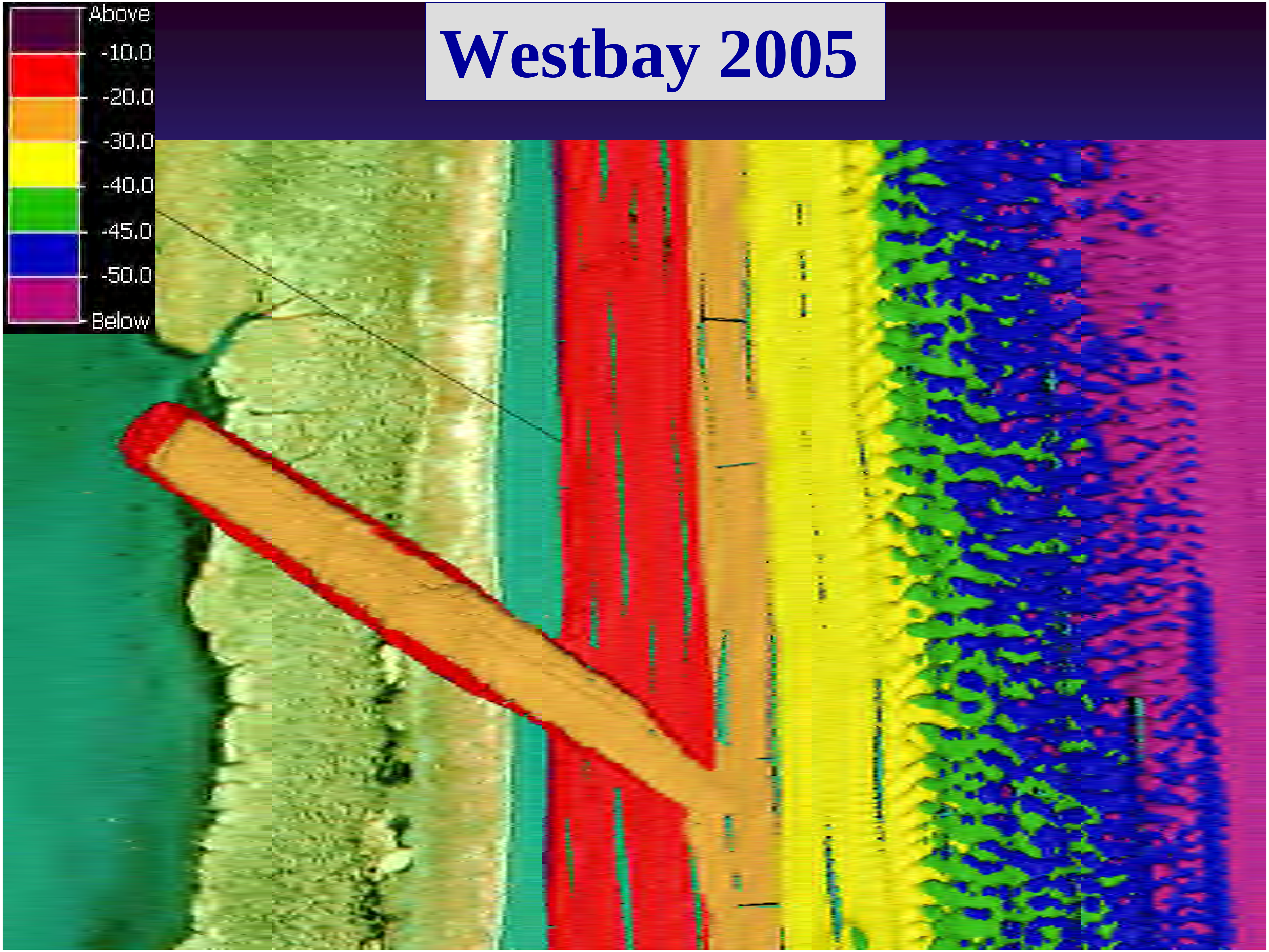
River Flood Control

Hurricane Flood Control

Environmental Enhancement

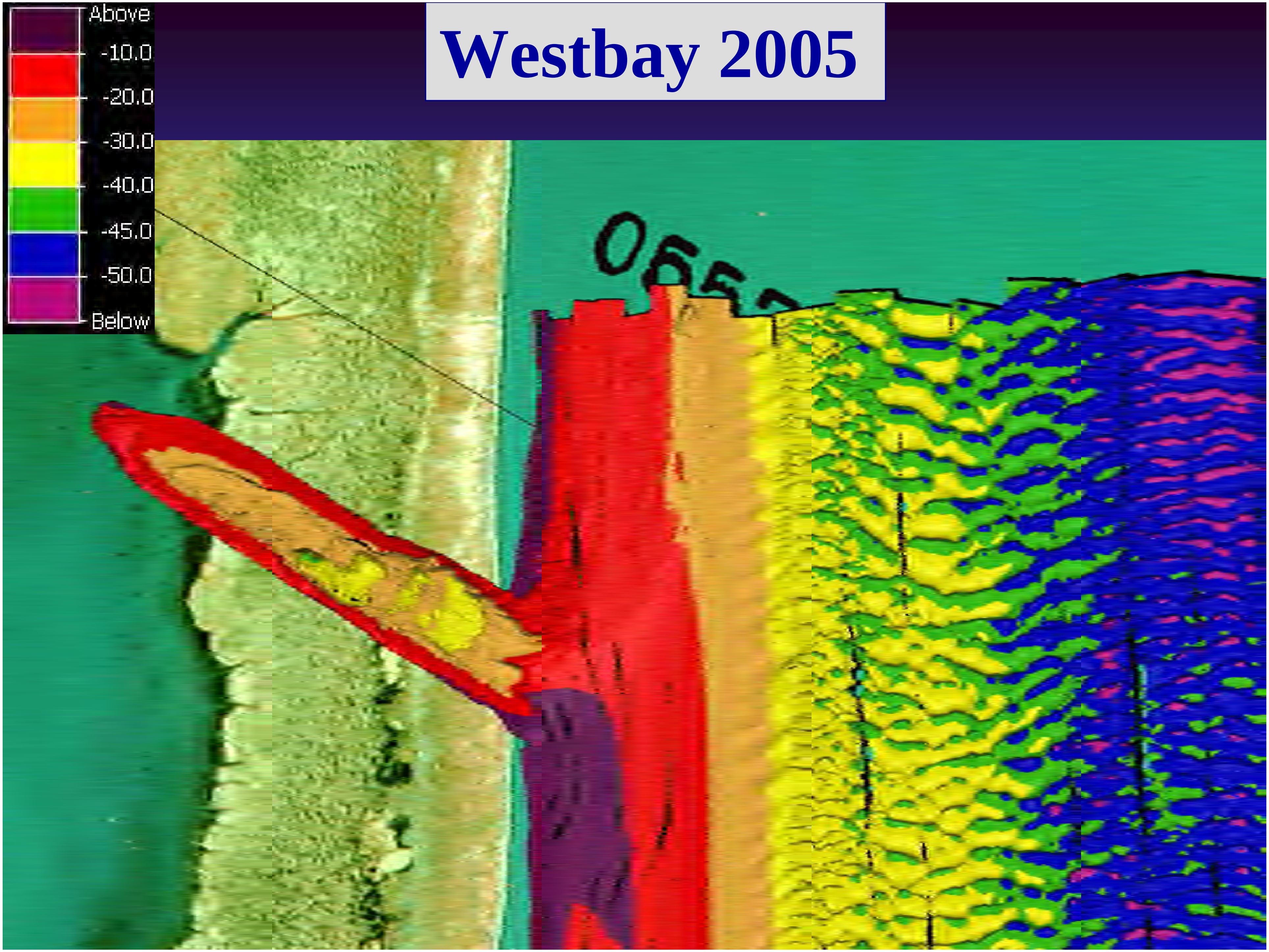
Wetlands Restoration

Support for Others

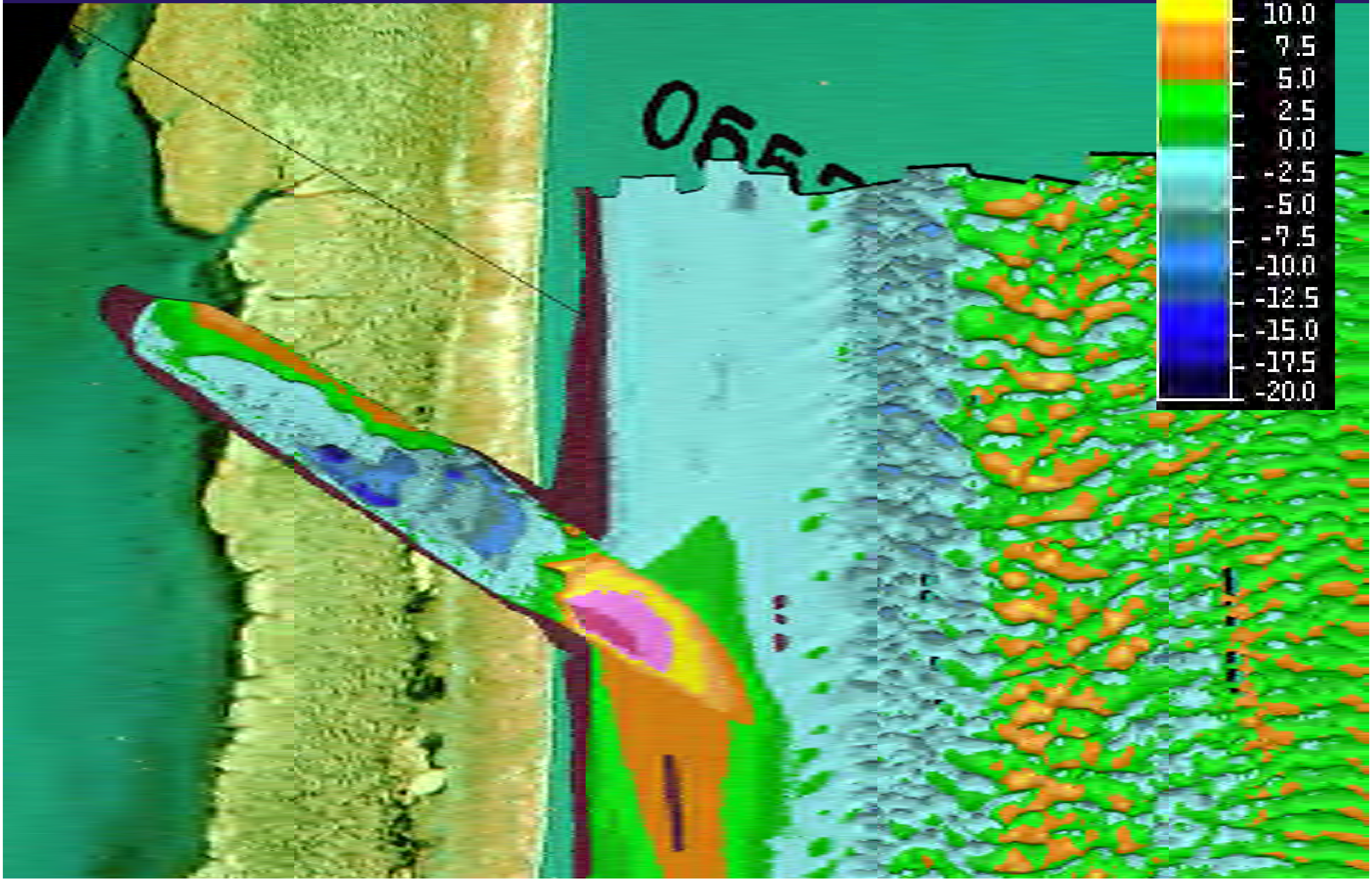


Westbay 2005
Above
-10.0
-20.0
-30.0
-40.0
-45.0
-50.0
Below

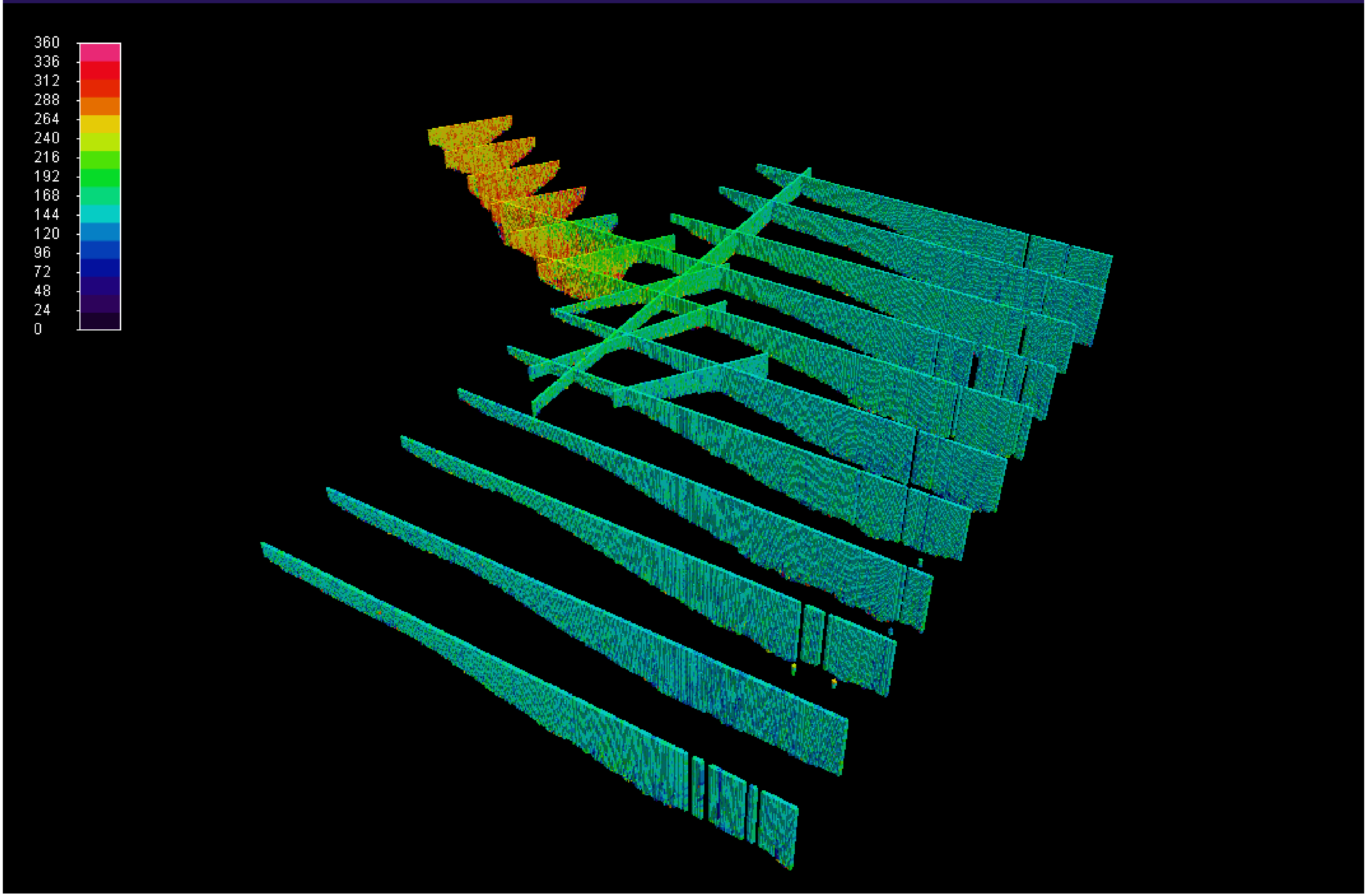
Westbay 2005



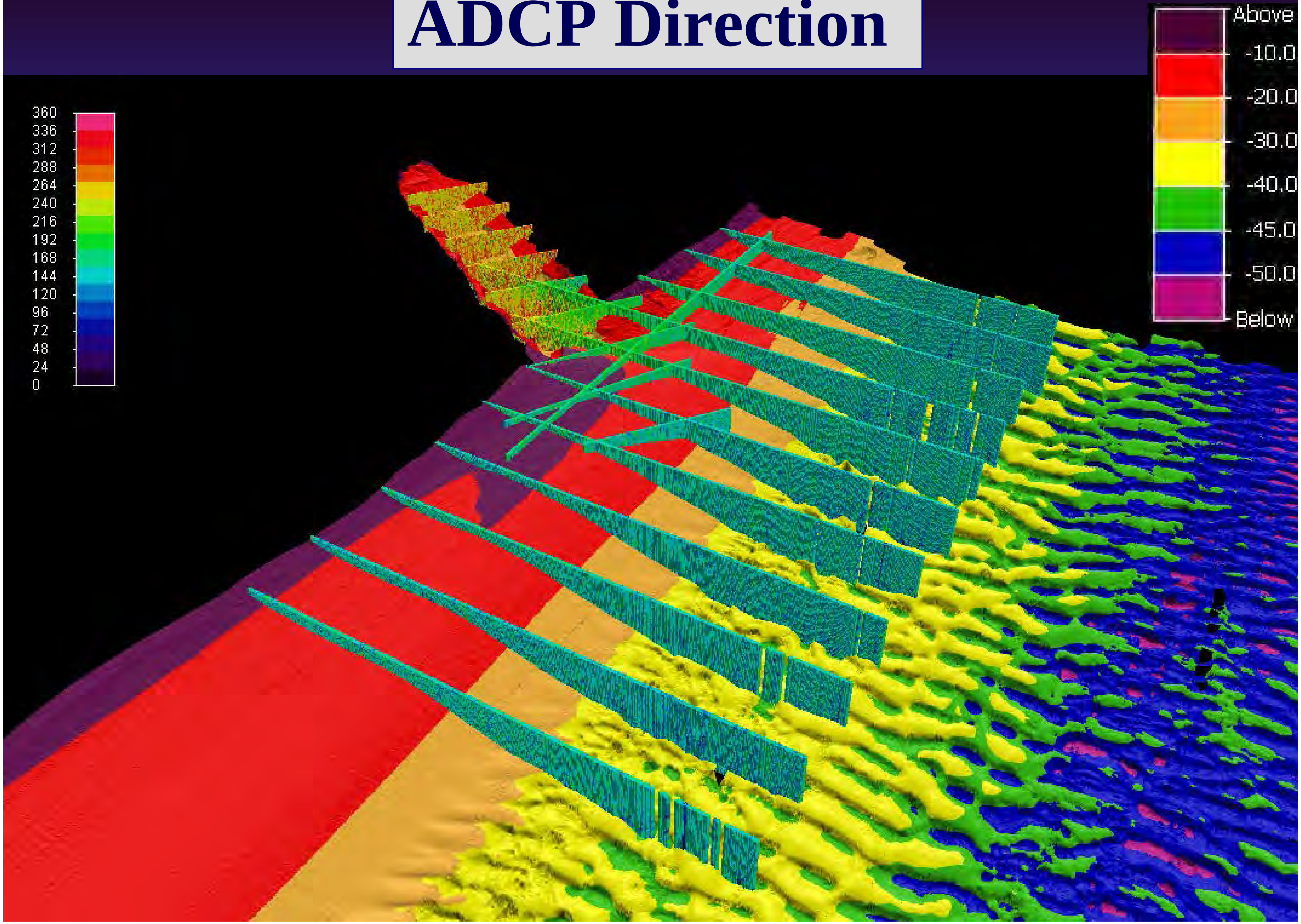
Surface Difference 2004 vs 2005

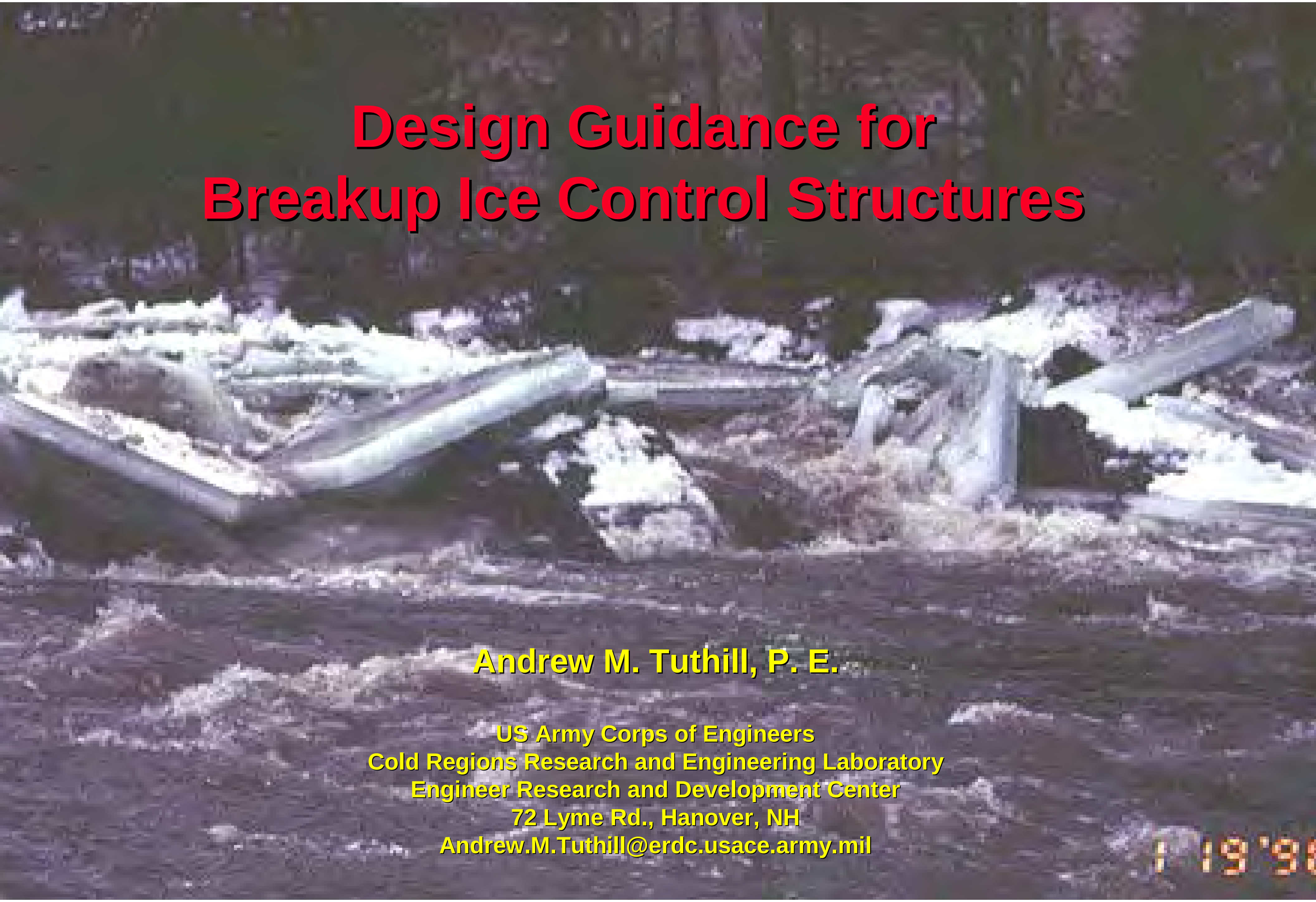


ADCP Direction



ADCP Direction





Design Guidance for Breakup Ice Control Structures

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Objectives

- Overview breakup ice jam processes and related problems of ice jam flooding and under ice scour.
- Describe the evolution in breakup ice control structure (ICS) design, focusing on recent advances and ongoing research. Illustrate with examples of existing and soon-to-be-built structures.
- Highlight important aspects of ICS design and describe some of the available design tools.
- Describe limitations of current pier ICS designs current research to address deficiencies.
- Explain rationale and objectives for ICS Design EM Chapter currently in preparation.

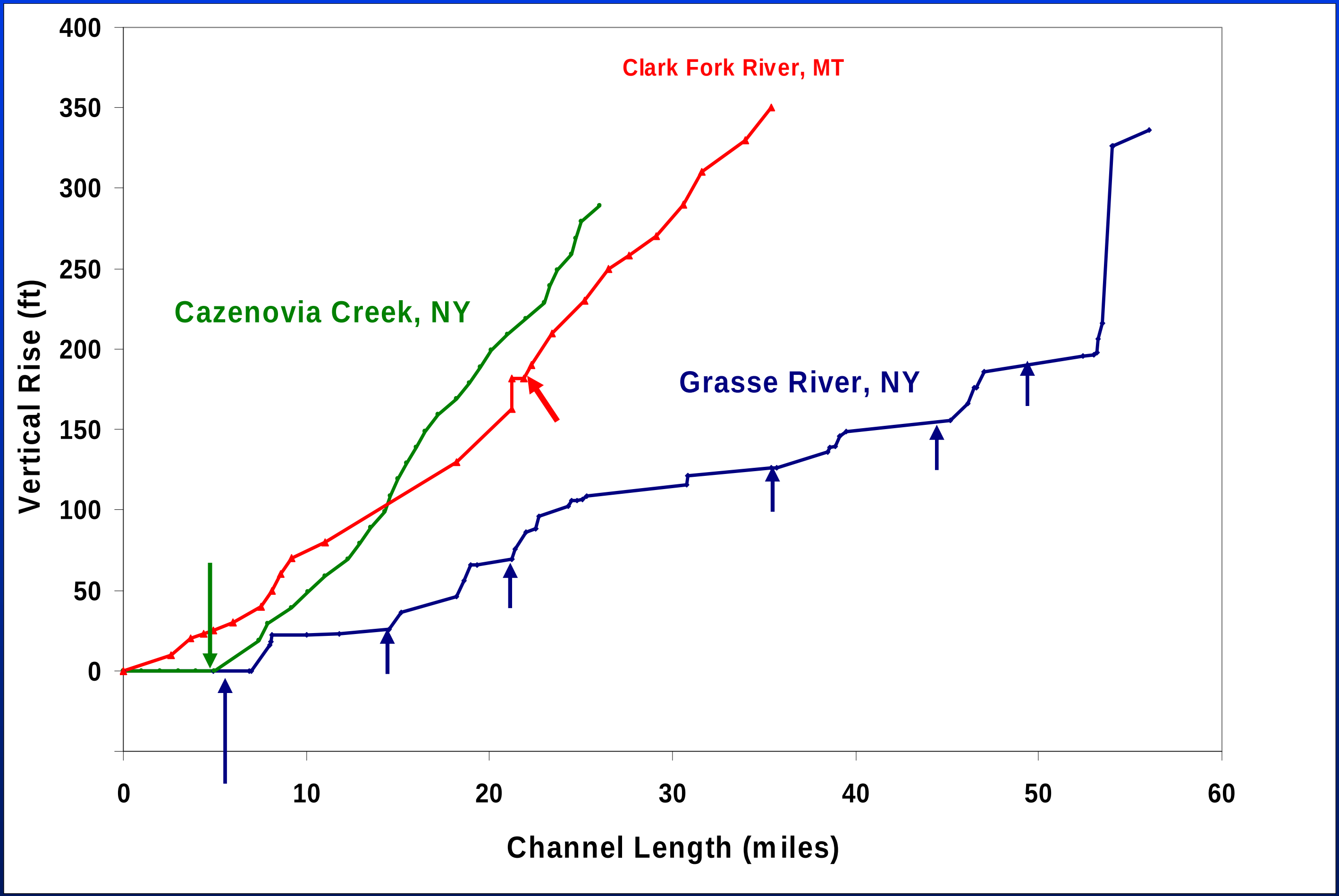
Breakup Ice Jam Processes and Related Problems

- Ice-out on rivers can range for gradual melt-out to dynamic, downstream-progressing breakup events. The latter type can result in ice jams, ice jam flooding and scour of river bed sediments.
- Ice jam flooding often occurs in small remote communities, causing localized damages that require low cost solutions.
- Because ice jams often occur on pristine rivers, solutions must have low environmental impact and not interfere with fish or sediment passage, or recreational uses of the river.
- Recently, the role of breakup ice control has has expanded from flood mitigation to to remediation of contaminated sediment.

Characterizing the Ice Jam Problem

- Research frequency and severity of past ice jam events
  - CRREL Ice Jam Database, newspapers, interviews, etc.
  - River inspection for ice tree scars, damage to banks, structures, etc.
  - Hindcasting analysis based on historic hydro-meteorological data
- Investigate the nature of ice breakup and identify a reasonable worst case scenario for ICS design.
  - Assess likelihood of dynamic breakup vs. thermal meltout.
  - Determine if ice-out typically occurs as a single downstream-progressing breakup front, or series of simultaneous jams.
  - Identify source reach supplying ice to the problem jam.
  - Determine a maximum probable ice volume, based on historic jams or probable ice source reach.

River Gradient, Breakup Progression, Ice Jam Location and Ice Jam Source Reach

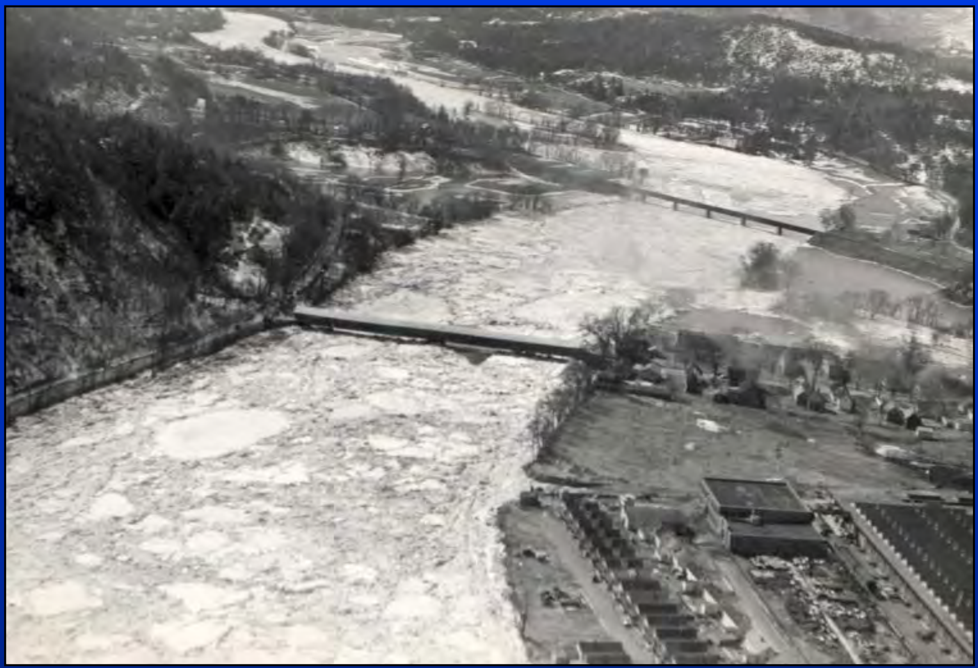


- Continuously steep river grading into backwater reach: Single breakup event forming a large jam near mouth.

- Stepped river profile: Ice breaks up in sections or in a downstream progressing sequence.

Typical Ice Jam Locations

Transitions from steep to mild slope



Ice jam on the Connecticut River at Windsor, VT above the head of the Bellows Falls Dam impoundment.

Channel constrictions, bends and meanders

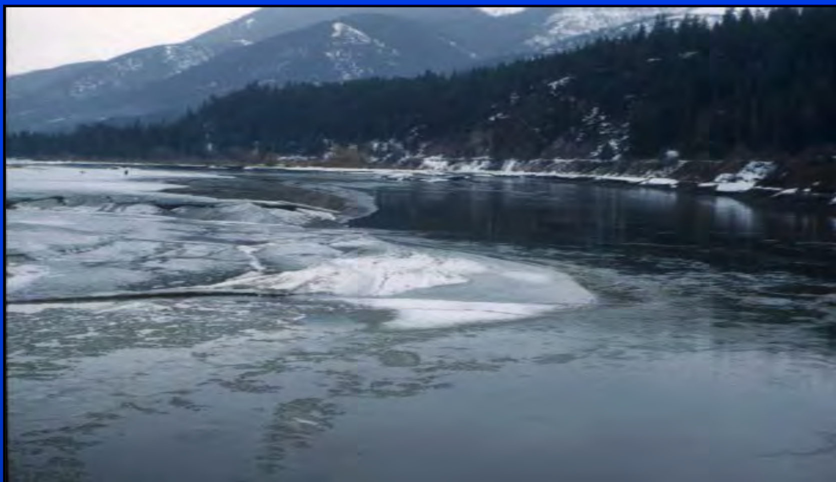
Ice jam in constricted bend in the Androscoggin River downstream of Canton, ME.

Also: bars, islands, dams & bridge openings

Both these events caused significant residential flooding

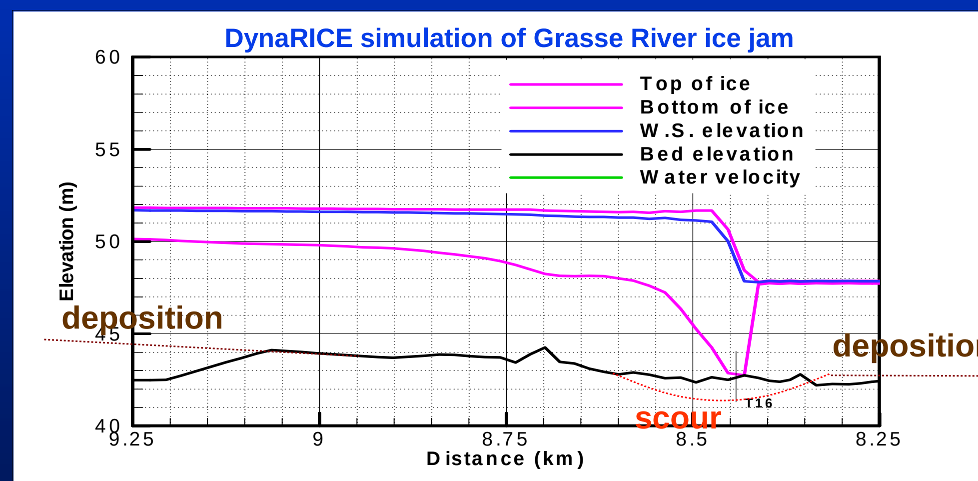
Common sediment deposition areas frequently coincide with ice jamming locations, resulting in a recurring deposition-ice jam scour cycle.

Examples of Ice Jam Scour and Transport of Contaminated Sediment



Milltown Dam, Clark Fork River, MT

Grasse River, Massena, NY

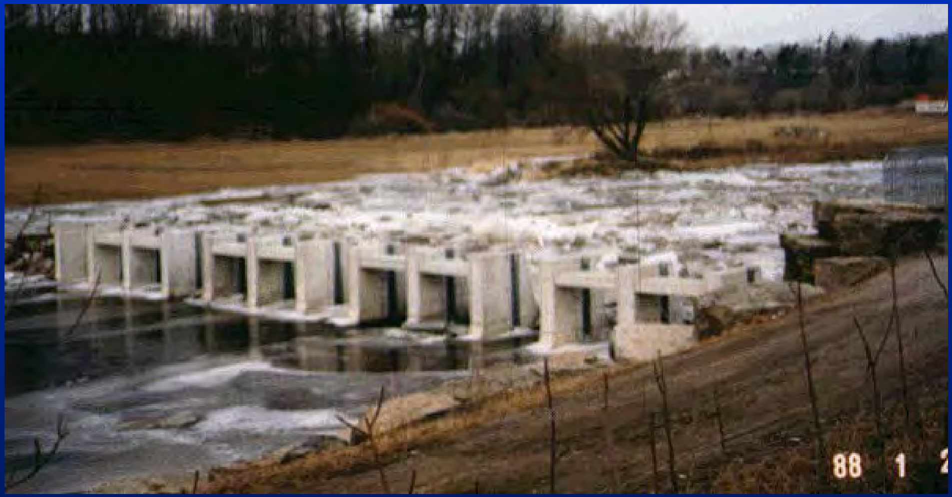


Both EPA Superfund Sites. CRREL participating in ice evaluations and mitigation.

Evolution in Breakup Ice Control Structure Design

1960's 40-ft-high dam, Chaudiere River, St. Georges, QUE

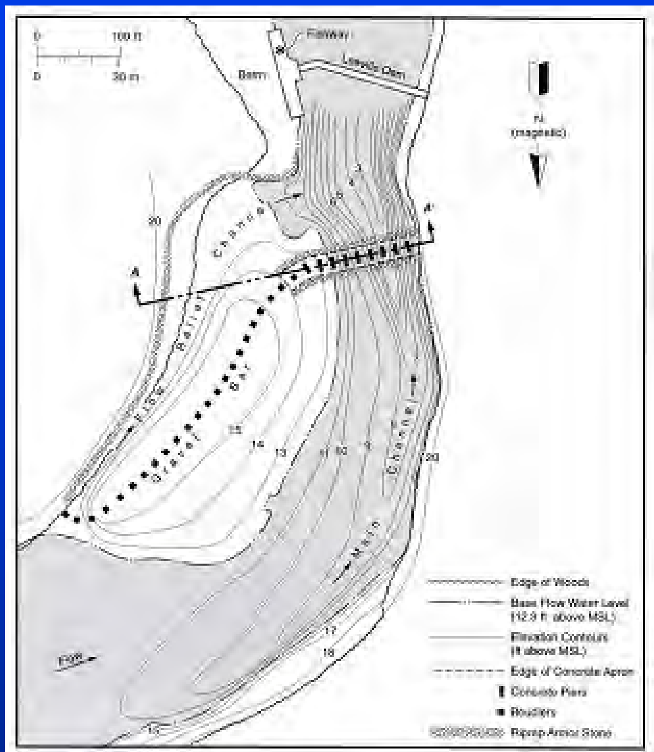
1970's Riviere Ste. Anne, St Raymond, Quebec, 15-ft-high weir with piers 20-ft-apart, all flow over weir.

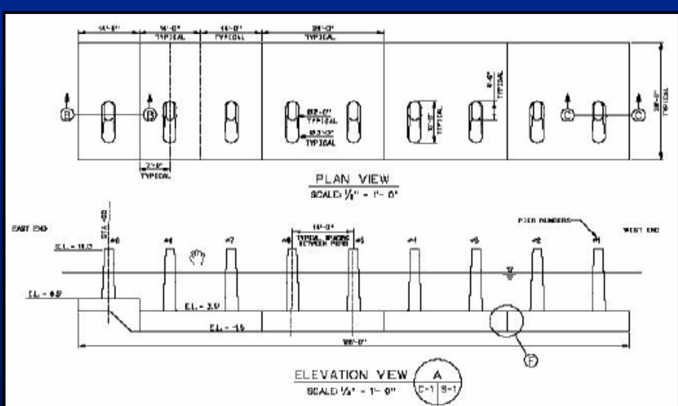


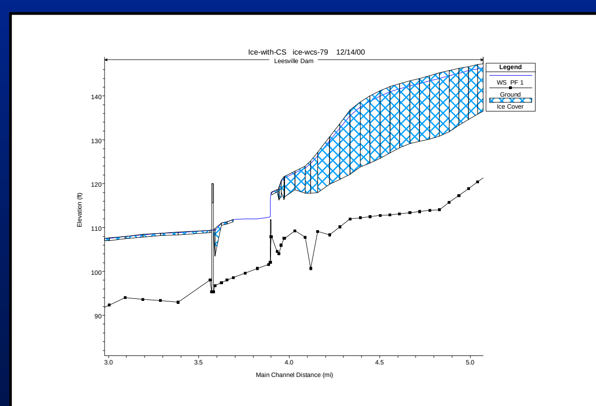
1986 Credit R., Mississagua, ONT., Piers 6-ft-apart, grounded jam in channel, bypass flow via floodplain.

1994 Lamoille R., Hardwick, VT., Grounded jam behind boulders, 14-ft gaps, bypass flow via tree covered floodplain (CRREL design). Monitored by CRREL as field site. No ice jam flooding since construction.

Scheduled for this summer-fall: Salmon River ISC, East Haddam, CT







Leesville Dam lowered 10 ft in 1979 for safety and construction of fish ladder.

Ice now passes crest to jam in tidal reach downstream, flooding houses.

Much sediment has eroded from former impoundment to deposit lower river decreasing recreational value.

ICS design by CRREL and NAE consists of piers across channel with adjacent gravel bar to bypass water flow around jam.

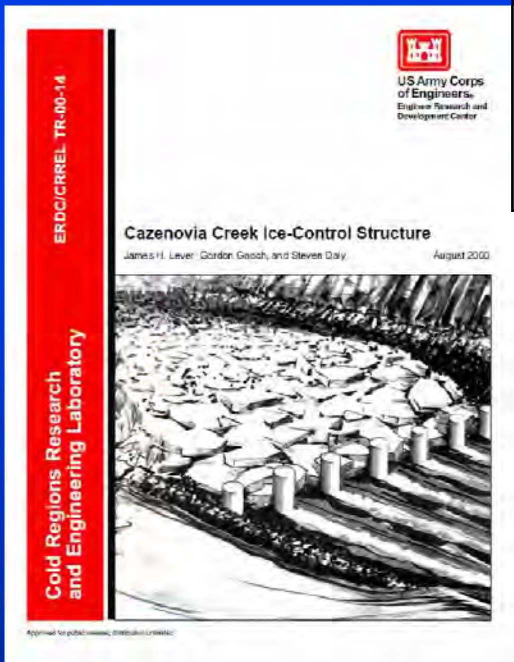
Design relied on HEC-2 and HEC-RAS simulations using ice jam routines.

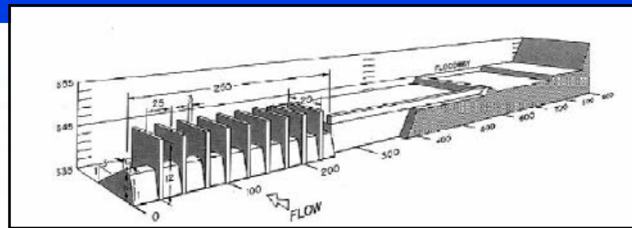
Design includes a sedimentation basin upstream of the piers.

Upstream reach uninhabited state park ideal for ice storage.

Strong support from the State of Connecticut DEP and local residents.

Currently Under Construction: Cazenovia Creek ISC, West Seneca, NY





Site of frequent severe ice jams and ice jam floods with high damages.

ICS design by CRREL and LRE consists of piers across channel with adjacent floodplain to bypass water flow around jam.

Design based on Hardwick ICS, CRREL physical model study, HEC-RAS and CRREL DEM simulations.

Although floodplain uninhabited, the high number of affected parcels complicated the land easement process and raised project costs.

Due the long history of flooding in West Seneca, strong local support for the project.

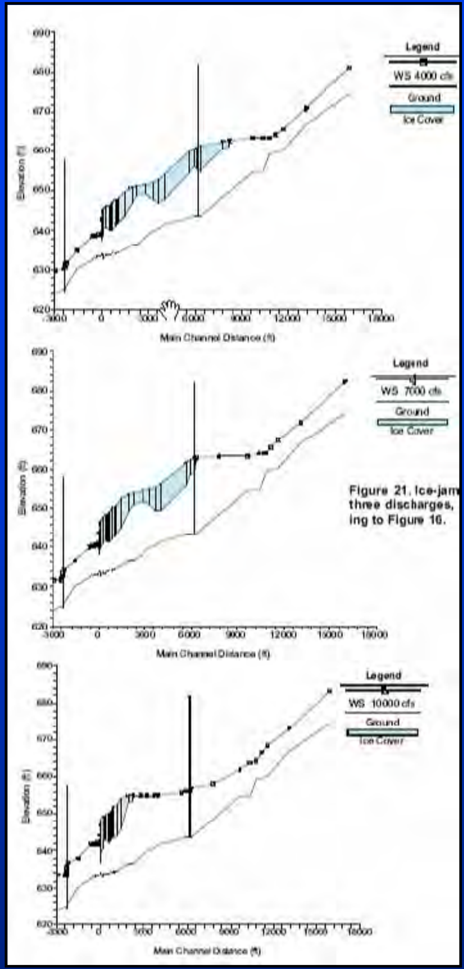
Lever (2000) documents the design process. *Excellent* ICS design reference.

Important Hydraulic Aspects of ICS Design

- Select design event based on historical info, analysis of historical breakup discharge, air temperature and precip. data.
- Model existing conditions ice jam in historic problem area. Validate model against observed data. Estimate ice jam volume.
- Evaluate upstream ICS sites and select preferred site.
- Based on pre-breakup ice conditions near ICS, predict how run will impact structure.
- Model ice accumulations at structure and historic jam site for range of breakup scenarios and ice parameters such as ice roughness, under ice water velocity and ice jam volume.
- Evaluate stability of retained ice accumulation based on under-ice water velocity and ice jam thickness profile.
- Evaluate relief flow channel capacity, (Manning Eq., HEC-RAS) and how flow escapes and re-enters the main channel.

Hydraulic Aspects of ICS Design

- Estimate/calculate ice forces on structure: Lever (2000), AASHTO code.
- Evaluate ice storage capacity of upstream channel and floodplains.
- Analyze upstream water level rise resulting from ICS, considering potential ice release at structure and progressive melting.
- Estimate shear forces on bed and banks in vicinity of structure to be used in design of bed protection.
- Estimate ice retention capacity of ICS and possible failure modes (compare to similar structures or physical model).



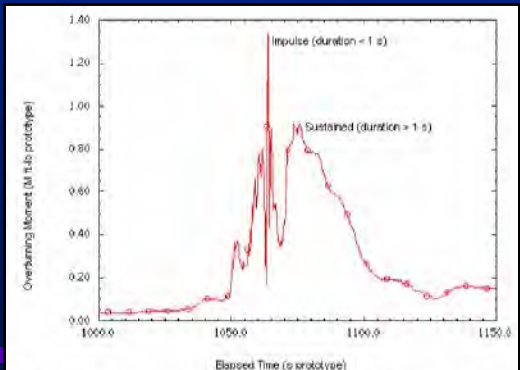
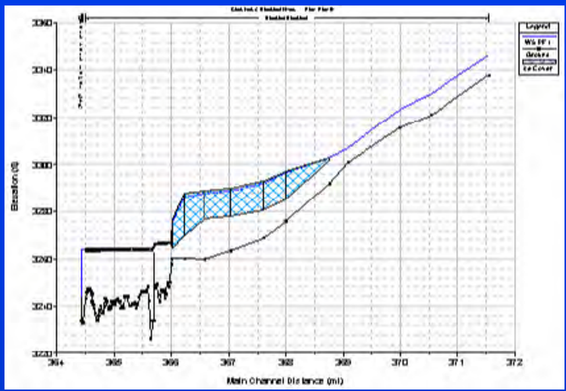


Figure 9. Measured downstream overturning moment (test 5 M1), showing peak impulsive and sustained moments.

ICS Design Tools



- Classic 1-D hydraulic methods such as Manning equation and equilibrium ice jam theory (EM 1110-2-1612 “Ice Engineering” Chapter 4)
- HEC-RAS with ice jam option bracketing accepted range of ice parameter values, such as ice roughness and under ice water velocity for ice jam erosion.
- State of the art ice-hydraulic models such as DynaRICE and the CRREL DEM
- Ice-hydraulic physical models with plastic or natural ice.

Increasing

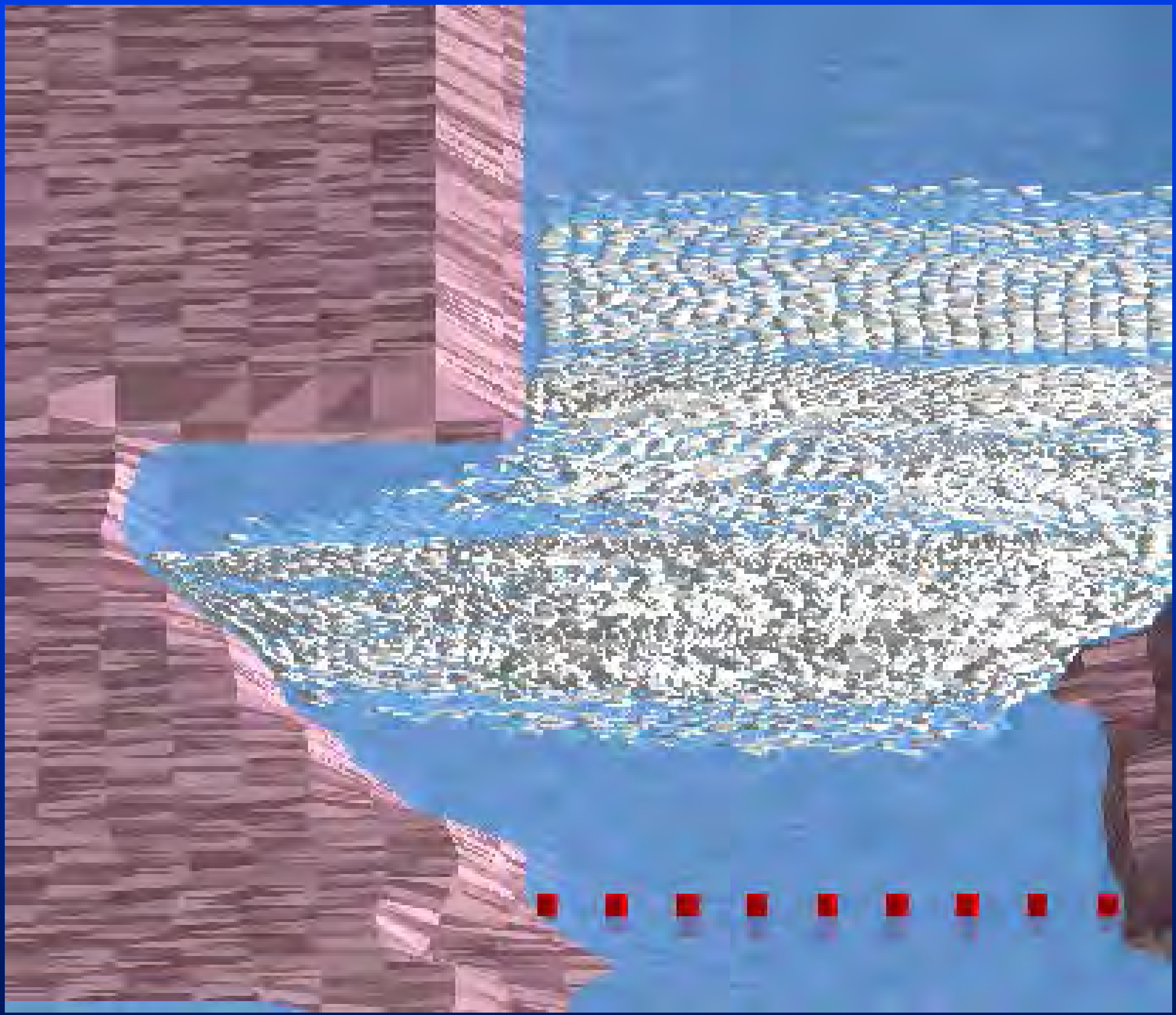
Time

Cost

Confidence

& Reliability

CRREL DEM Simulation of Ice Run Impacting Cazenovia Creek ICS



http://www.crrel.usace.army.mil/sid/hopkins_files/Riverice/Caz.htm

Limitations of Pier ICS Designs and Current Research

- Many ice jam problem locations lack upstream ice retention sites with floodplains for relief flow.
  - Existing sites with overbank relief flow may be too far upstream to retain sufficient ice to solve problem.
  - Land issues may prevent use of sites with floodplains for ICS.
  - Concept of in-channel flow relief under development (CRREL & Grasse R. project).
- Pier structures not 100% reliable. Conditions for under-ice erosion, piping, and release poorly understood.
  - At some elevated discharge the ice may pass the structure, usually as a release between two or more piers.
  - This de-phasing of the hydrograph and the breakup ice run may alleviate the downstream ice jam problem but the process is difficult to quantify and design for.
  - Research needed to quantify parameters for ice release at pier structures.
  - Canadians working on pier-net ICS designs (Morse et al, Laval, U.)
- Concrete piers considered by some as unaesthetic.
  - Hardwick granite blocks represent a more natural looking alternative
  - CRREL model tests of man-made island arrays as alternative to piers.

CRREL Physical Model Tests of Pier ICS Without Flow Relief

Cazenovia Creek ICS model with floodplain walled off.

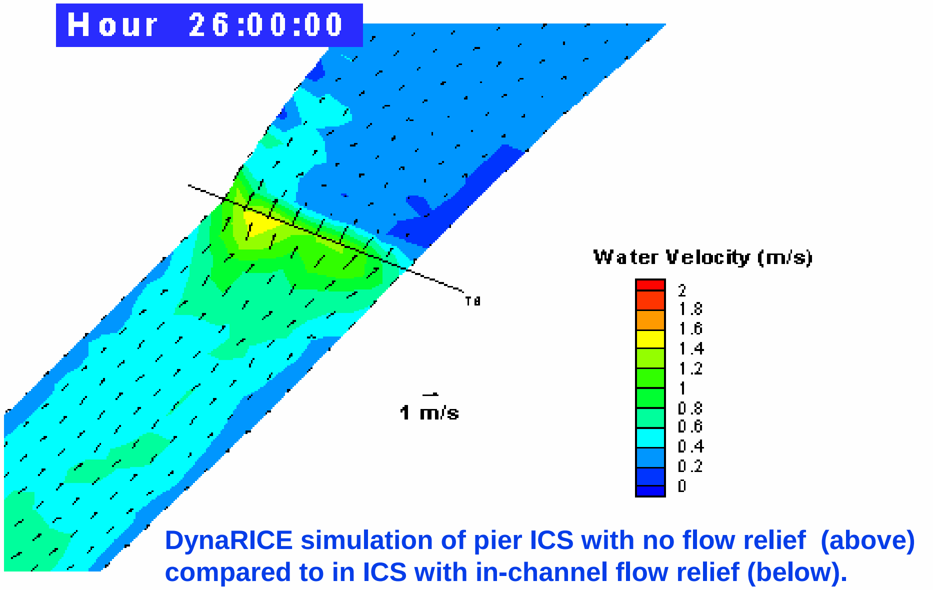
Ice blowout typically occurred at about half the discharge of the overbank relief flow cases. Morse et al. found similar.

Array of artificial islands as a more aesthetic alternative to concrete piers. Performance similar to piers.

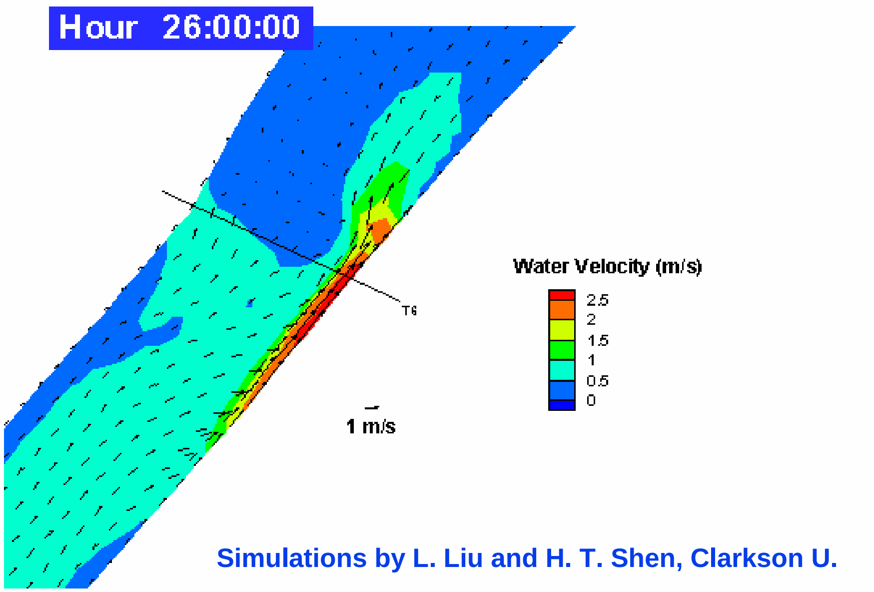
US Army Corps of Engineers

Engineer Research and Development Center

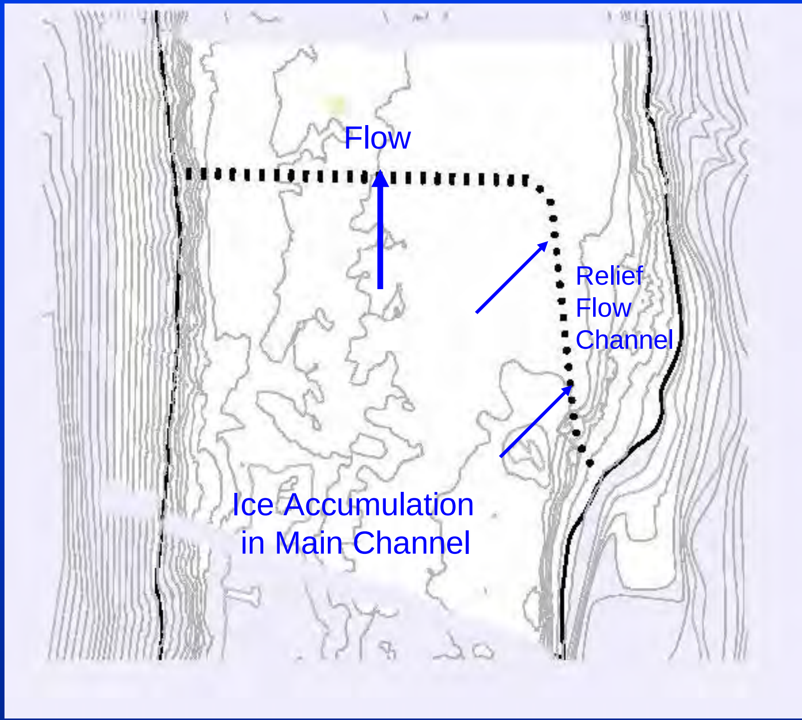
In-Channel Flow Relief Concept



DynaRICE simulation of pier ICS with no flow relief (above) compared to in ICS with in-channel flow relief (below).



Simulations by L. Liu and H. T. Shen, Clarkson U.



Longitudinal row of piers allow water flow to to bypass jam in main channel reducing under-ice water velocity and the potential for ice erosion and jam failure.

Physical model tests will improve confidence in concept.

EM Chapter on ICS Design

- Distill existing breakup design guidance into a single concise document.
- Offer logical step-by step approach to ICS design.
- Where possible, avoid dependence on time-consuming and costly numerical and physical modeling.
- Provide guidance on which situations require a more sophisticated design approach, provide direction and references.

Acknowledgements

This research is funded under the Flood and Coastal Storm Damage Reduction Program work unit: *Ice- Affected Structures*. It builds on the work of James Lever and others, funded by the Cold Regions Engineering Program WU: *Low Cost Ice Control for Small Rivers*, the Buffalo District and FEMA. In addition, the Alcoa-sponsored Grasse River Ice Evaluation reimbursable study has provided experience in the application of of ice control to remediation of contaminated sediment.

US Army Corps
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Engineer Research and Development Center

HH&C Community of Practice
Tri-Service Infrastructure Conference
2-5 August 2005 - St. Louis

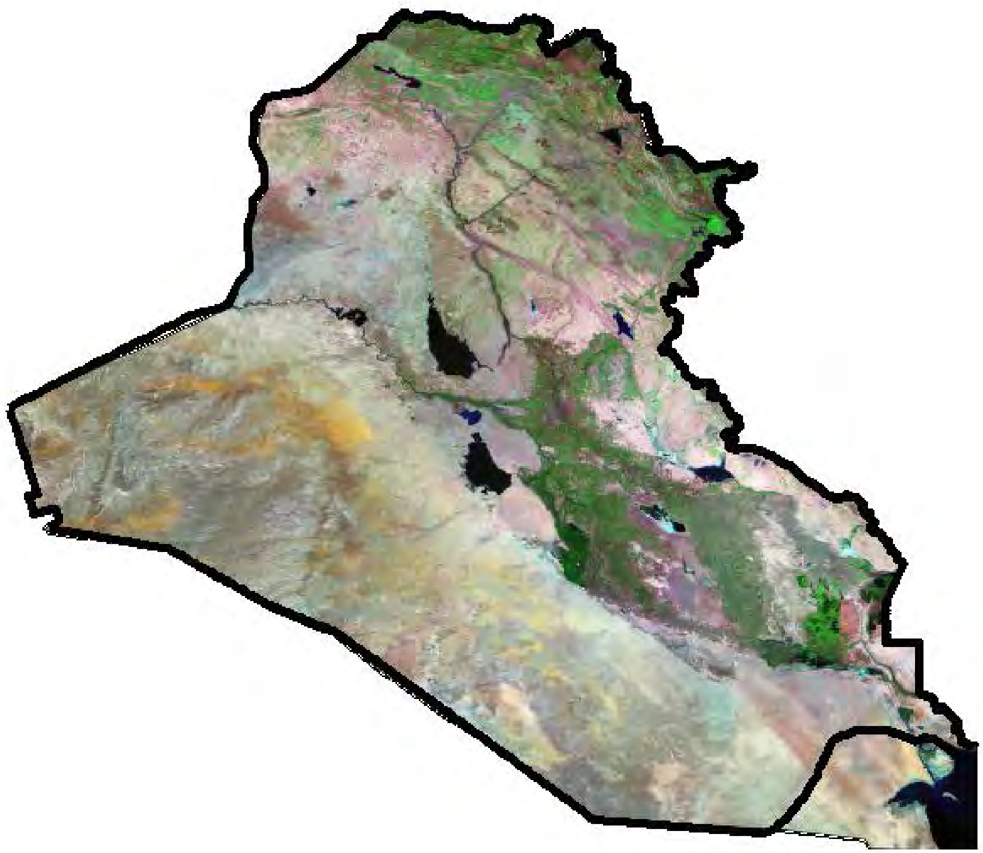
Iraq Ministry of Water Resources Capacity Building

US Army Corps of Engineers®

Michael J. Bishop, John W. Hunter, Jeffrey D. Jorgeson, Matthew M. McPherson, Edwin A. Theriot, Jerry W. Webb, Kathleen D. White, and Steven C. Wilhelms

Iraq MoWR Capacity Building

- **Introduction**
  - Background
  - Goals
- **Needs Analysis**
  - Data & Evaluation
  - Results
- **Training Plan**
- **Progress to Date**
- **Way Ahead**



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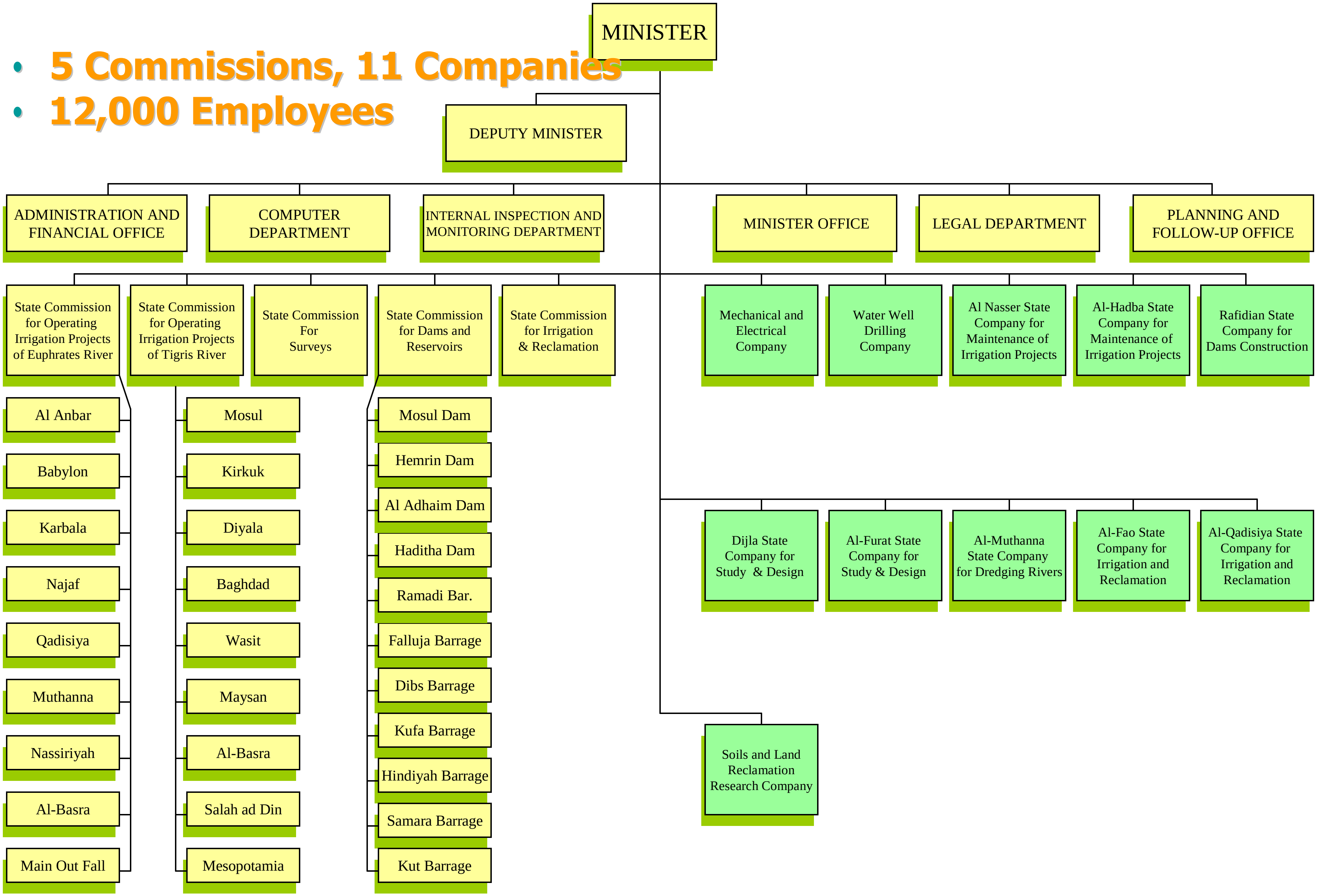
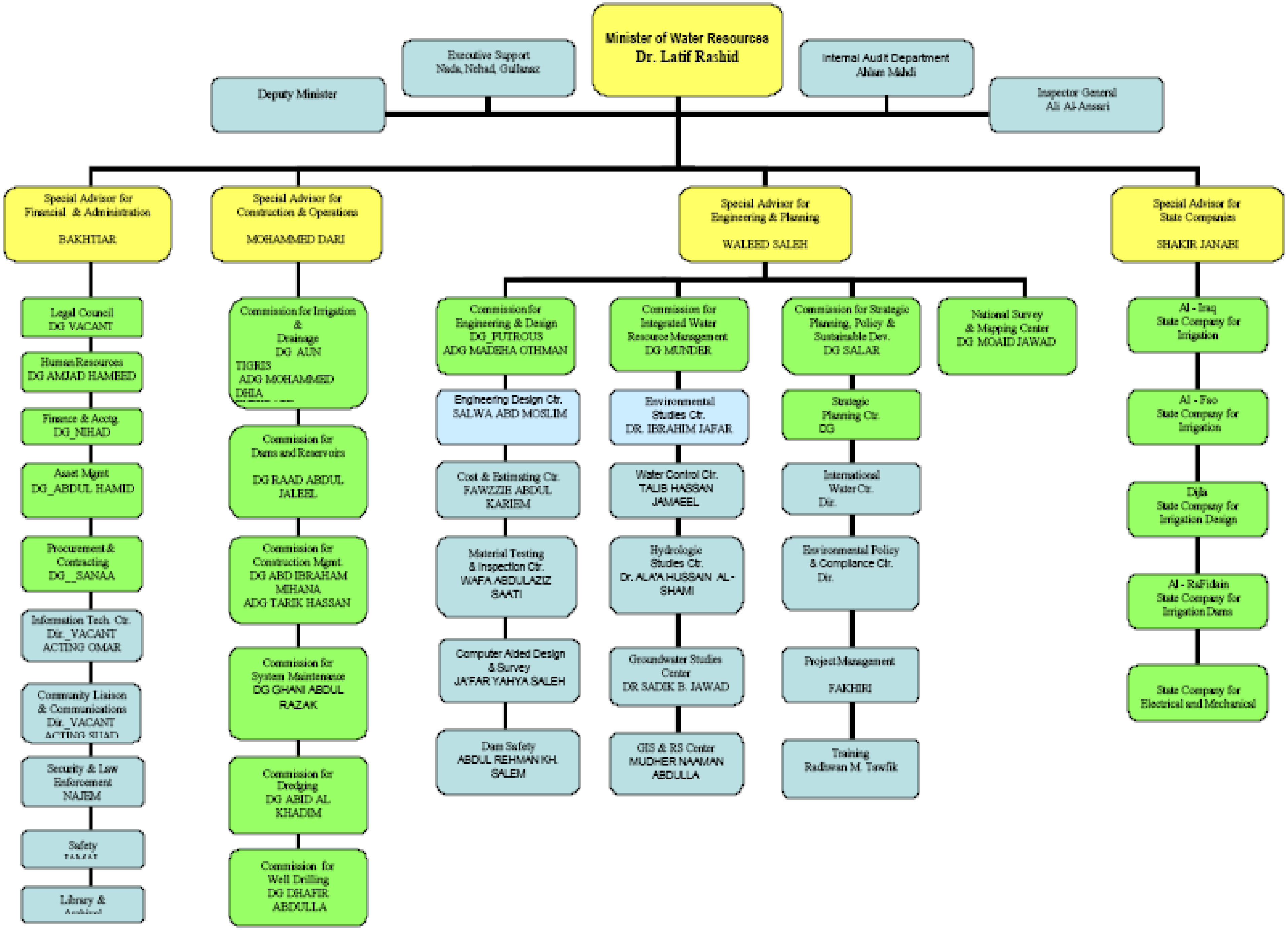
Background

- The Iraq Ministry of Water Resources (MoWR) established in 2003
  - Goal: improve the planning, construction, operation, and management of water resources in Iraq
  - Primarily a restructuring of the Ministry of Irrigation with added functional elements
  - Changes to many of the existing roles and responsibilities within the MoWR
- USACE is supporting the MoWR through a training program designed to build capacity within the MoWR to meet its future demands

Previous Organization

- 5 Commissions, 11 Companies
- 12,000 Employees





Minister of Water Resources
Dr. Latif Rashid
Executive Support
Nada, Nehad, Gullanar
Internal Audit Department
Ahlam Mahdi
Deputy Minister
Inspector General
Ali Al-Ansari
Special Advisor for
Financial & Administration
BAKHTIAR
Special Advisor for
Construction & Operations
MOHAMMED DARI
Special Advisor for
Engineering & Planning
WALEED SALEH
Special Advisor for
State Companies
SHAKIR JANABI
Legal Council
DG VACANT
Human Resources
DG AMJAD HAMEED
Finance & Acctg.
DG NIHAD
Asset Mgmt
DG ABDUL HAMID
Procurement &
Contracting
DG SANAA
Information Tech. Ctr.
Dir. VACANT
ACTING OMAR
Community Liaison
& Communications
Dir. VACANT
Security & Law
Enforcement
NAJEM
Safety
Library &
Commission for Irrigation
&
Drainage
DG AUN
TIGRIS
ADG MOHAMMED
DHIA
Commission for
Dams and Reservoirs
DG RAAD ABDUL
JALEEL
Commission for
Construction Mgmt.
DG ABD IBRAHAM
MIHANA
ADG TARIK HASSAN
Commission for
System Maintenance
DG GHANI ABDUL
RAZAK
Commission for
Dredging
DG ABID AL
KHADIM
Commission for
Well Drilling
DG DHAFIR
ABDULLA
Commission for
Engineering & Design
DG FUTROUS
ADG MADEHA OTHMAN
Engineering Design Ctr.
SALWA ABD MOSLIM
Cost & Estimating Ctr.
FAWZZIE ABDUL
KARIEM
Material Testing
& Inspection Ctr.
WAFA ABDULAZIZ
SAATI
Computer Aided Design
& Survey
JA'FAR YAHYA SALEH
Dam Safety
ABDUL REHMAN KH.
SALEM
Commission for
Integrated Water
Resource Management
DG MUNDER
Environmental
Studies Ctr.
DR. IBRAHIM JAFAR
Water Control Ctr.
TALIB HASSAN
JAMAEEL
Hydrologic
Studies Ctr.
Dr. ALA'A HUSSAIN AL-
SHAMI
Groundwater Studies
Center
DR SADIK B. JAWAD
GIS & RS Center
MUDHER NAAMAN
ABDULLA
Commission for Strategic
Planning, Policy &
Sustainable Dev.
DG SALAR
Strategic
Planning Ctr.
DG
International
Water Ctr.
Dir.
Environmental Policy
& Compliance Ctr.
Dir.
Project Management
FAKHIRI
Training
Radhwan M. Tawfik
National Survey
& Mapping Center
DG MOAID JAWAD
Al - Iraq
State Company for
Irrigation
Al - Fao
State Company for
Irrigation
Dijla
State Company for
Irrigation Design
Al - RaFidain
State Company for
Irrigation Dams
State Company for
Electrical and Mechanical

What is Capacity Building?

- **Visible leadership in the form of meaningful commitment by senior staff**
- **A participatory process that is organization-wide**
- **An open and transparent process to achieve capacity building**
- **Effective communication of capacity building goals and objectives at all levels**
- **General buy-in and acceptance of the capacity building program**
- **Techniques, methods, and metrics adapted to the local situation and needs that encourage risk, failure, success**
- **Clear objectives and priorities phased according to resources and workload**
- **Management accountability through open decision-making and explicit responsibilities**
- **Sufficient time and resources**

United Nations Development Program (UNDEP) (1998) “Capacity Assessment and Development In a Systems and Strategic Management Context.” UN Development Program Bureau for Development Policy, Management Development and Governance Division, Technical Advisory Paper No. 3

Needs Analysis

- Verify **mission, vision, roles, and responsibilities** of the functional elements within the MoWR
- Conduct detailed discussions of desired competencies, roles, and responsibilities with **special attention to knowledge gaps** by MoWR functional element to identify training needs and priorities
- Assess MoWR **physical infrastructure** to identify office and laboratory facilities, equipment, and training capabilities necessary to construct and operate a state-of-the-art integrated MoWR
- Provide MoWR with an overview of typical water resources management agency **organizational structures and technological advances** in the field of water resources
- Summarize the findings of the **initial consultation** team with respect to MoWR capacity building needs and desires
- Recommend further actions to be carried out in a **detailed capacity building plan**

Initial Consultation Team

- **John Hunter (CELRN), Michael Bishop (CEERD-EL), Matt McPherson (CEIWR-HEC)**
- **November-December 2004, Baghdad**

Initial Consultation

- Overviews
  - Goals and objectives
  - Water resources agency management &organizational structures
  - Advances in water resources management technologies
- MoWR Self-Assessments
  - Functional element roles and responsibilities

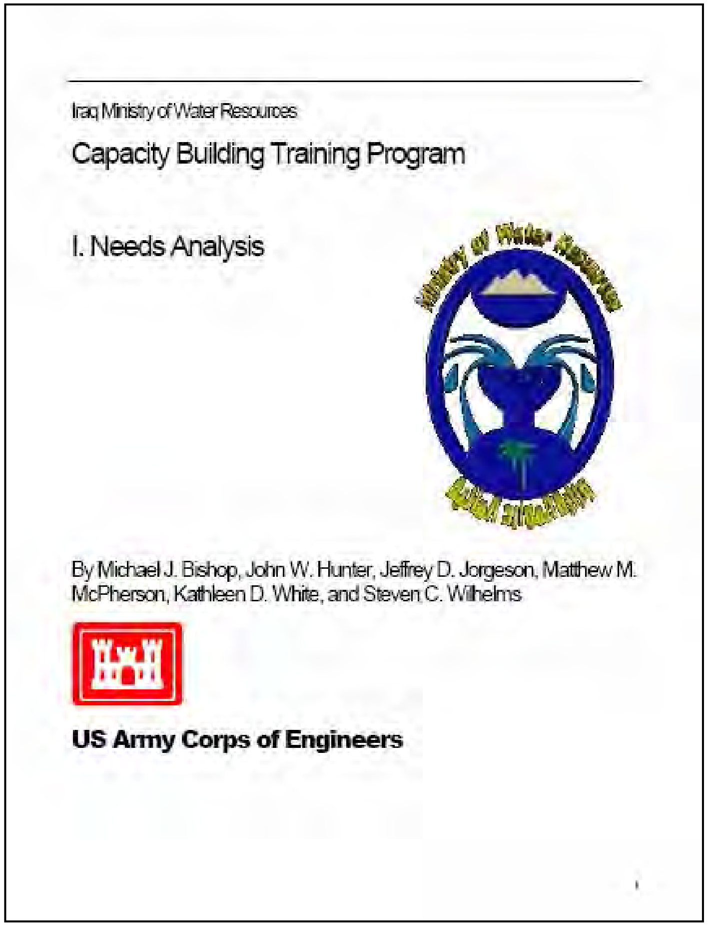
- Interviews
  - Commission for Irrigation and Drainage
  - National Survey and Mapping Center
  - Commission for WRM: Environmental Studies Center
  - Commission for WRM: Groundwater Studies Center
  - Commission for WRM: GIS and Remote Sensing Center
  - Commission for WRM: Water Control Center
  - Commission for WRM: Hydrologic Studies Center
  - Commission for Engineering and Design

Physical Infrastructure:
Headquarters

- Offices of the Minister, key department heads, administrative staff
- Meets the needs of the Ministry
- Present system of satellite and cell phones is unreliable
- No centralized computer system for payroll, human resources, email, networking, or multi-user access to database systems
- Firewalls, routers and other computer equipment needed for secure computer communication not evident

Physical Infrastructure:
Headquarters

Needs Analysis Results



Iraq Ministry of Water Resources

Capacity Building Training Program

I. Needs Analysis

By Michael J. Bishop, John W. Hunter, Jeffrey D. Jorgeson, Matthew M. McPherson, Kathleen D. White, and Steven C. Wilhelms

US Army Corps of Engineers

- **Research and Development**
- **GIS and CADD**
- **Water Resources Management**
- **Operation of Environmental Analysis Center**
- **Establishment of a regulatory or compliance authority**
- **Development of program and project management capabilities**

Needs Analysis Results

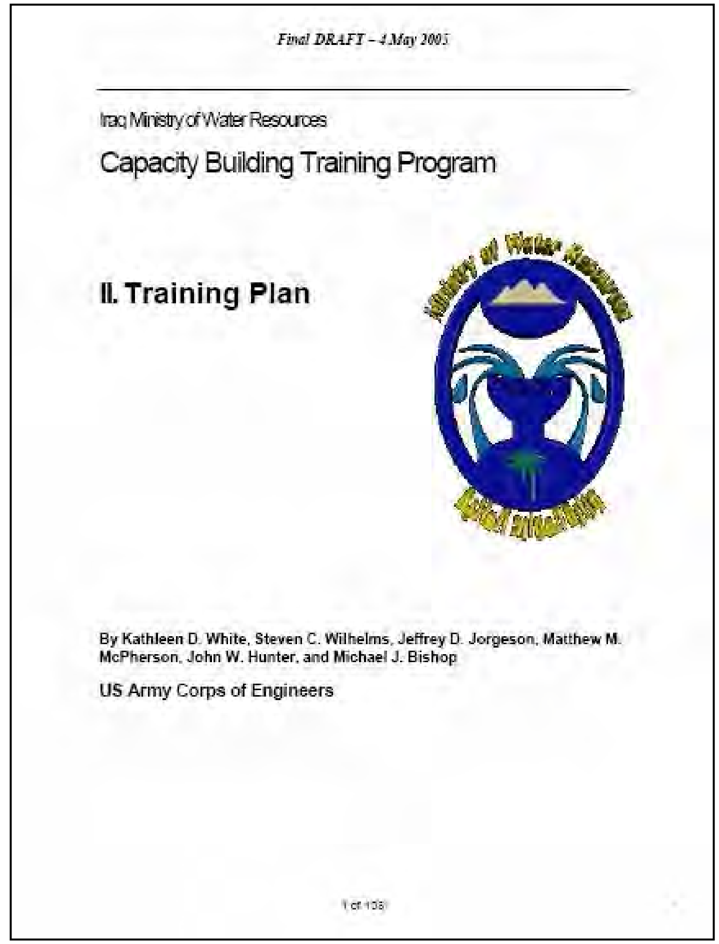
- Training for personnel staffing a Water Control Center
- Demonstration and hands-on training of snow and water gaging systems
- Short- and intermediate-term training for GIS, surveying, mapping, and CADD
- Formal classes on H&H software tools for water resource management
- Specific training for personnel dealing with irrigation issues
- Training for dam safety and assessment
- Demonstration training for personnel developing regulatory functions
- Training in research and development for hydraulics, environmental, and soil salinity laboratory personnel
- Training for personnel establishing an Environmental Analysis Center
- Specific training for program management of water resource projects
- "Reach-back" training and technical support for MoWR staff elements regarding training opportunities, equipment, software, etc.
- Leadership training for managers and supervisors
- Training for administrative personnel in budgeting, accounting, and financial management
- Training for IT personnel integrated across all ministries that deal with water

Activities By Others

- Hydrologic and hydraulic modeling at USACE HEC (USAID)
- GPS, Remote Sensing, and GIS training provided by ESRI in Jordan
- CADD training in AutoCADD and AutoDesk in UAE/Jordan
- Hydrometeorological gaging training from USACE HEC and US Geological Survey (USGS) (leveraged by us)
- On-going University training for future MoWR staff
- Technical assistance in irrigation, drainage, data acquisition, from Agricultural Reconstruction and Development for Iraq (ARDI)
- UNESCO training in water resource management and water project monitoring
- UNESCO to perform Phase I of a National Water Master Plan (USACE HEC involved)
- …….

Training Plan

- **Objectives:**
  - Provide examples of water resources management to define organizational structure, operations, and policies
  - Strengthen staff in the technical skills and personal leadership skills necessary for managing organizational change and growth
  - Create internal and external training programs
  - Develop and support peer-to-peer information exchanges
  - Provide education, training, development, and career management guidance to support a sustainable Training Center
  - Demonstrate business and financial processes, program and project management, and management of human resources


Final DRAFT – 4 May 2005

Iraq Ministry of Water Resources

Capacity Building Training Program

II. Training Plan

By Kathleen D. White, Steven C. Wilhelms, Jeffrey D. Jorgeson, Matthew M. McPherson, John W. Hunter, and Michael J. Bishop

US Army Corps of Engineers

Training Plan

- **4 Components:**
  - **Focused Technical Training (FT)**
  - **Core Cadre Training (CC)**
  - **Water Resources Management Training (WRM)**
  - **Technical Support (TS)**
- **Recognize all sources of training**
  - **Public sector**
  - **Private sector**
  - **Universities**

Type of Training	Method	Selection Process	Venue	Time	Performance Metrics
Focused Technical (FT) Training	Face-to-face	Selection	Iraq/ME	Refresher (1 week)	FT trainees implement technology
		Selection	Iraq/ME	In-depth (3-4 weeks)	FT trainees implement technology and provide support to others
		Nomination and Competitive Selection	U.S.	In-depth (1-2 months)	FT trainees implement technology
	Virtual	Selection	Iraq/ME	Intermittent	Successful completion of technical training module
Core Cadre (CC) Training	Face-to-face	Nomination and Competitive Selection	U.S.	In-depth (1-2 months)	CC trainees develop implementation plans for FT classes
		Selection	Iraq/ME	Refresher (1-4 weeks)	CC trainees perform successfully as trainers in FT classes
Water Resources Management (WRM) Training	Face-to-face	Selection	Iraq/ME	Refresher (1 week)	WRM trainees implement technology into functional element
		Selection	Iraq/ME	In-depth (2-4 weeks)	
		Nomination and Competitive Selection	U.S.	In-depth (1-2 months)	
	Virtual	Selection	Iraq	Intermittent	WRM trainees implement technology into functional element
Technical Support (TS)	Virtual (unless in-country resource is available)	N/A	Iraq	Less than a week	FY06: Joint PDT-MoWR TS program FY07: MoWR-run TS program
Business Practices	Consultant	N/A	Iraq	To be determined	WRM trainees implement technology into functional element

Training Plan

- **77 training opportunities identified ($2.5M unfunded)**
  - GIS, Surveying, Mapping, CADD
  - Hydraulic and Hydrology
  - Water Resources Management
  - Research and Development
  - Information Technology
  - Sediment Management / River Training
  - Environmental
  - Strategic Planning / Project Management
  - Engineering and Design
  - Project / Construction Management
  - Business Practices, Budgeting, Accounting, and Financial Management

Training Courses (next few months)

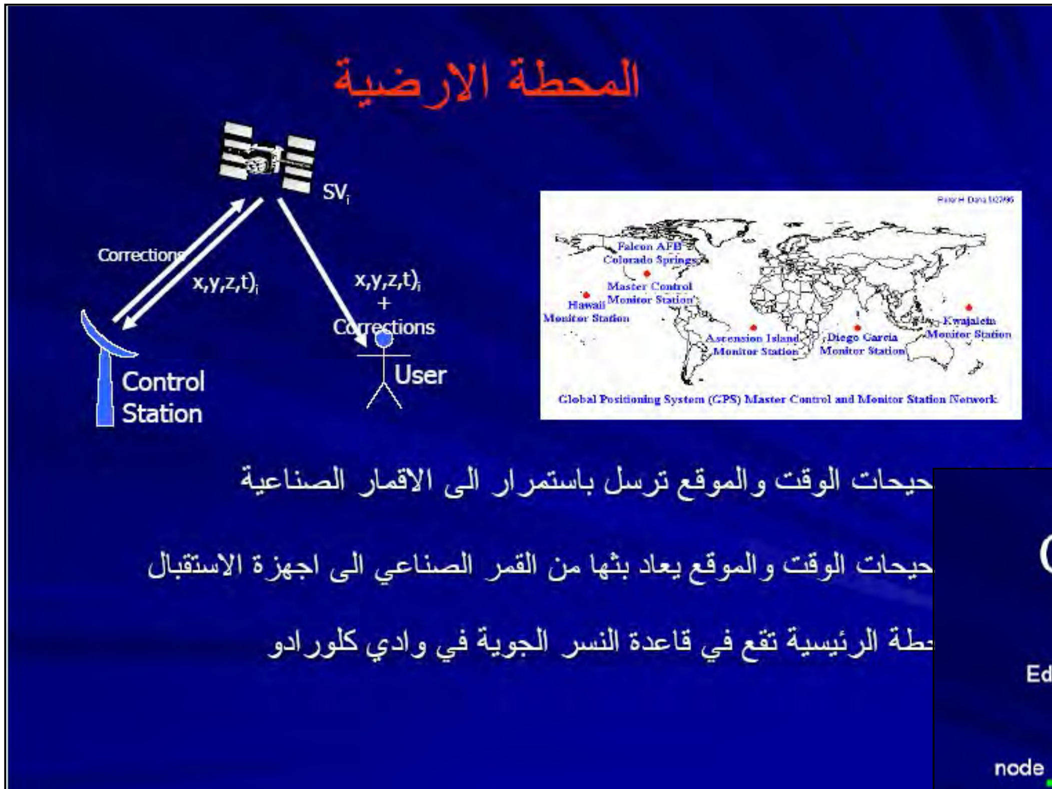
- Support to USAID Streamgaging (USGS and USACE, May 2005)
- GIS Core Cadre (June-July 2005)
- Dam Safety (USBR and USACE, August 2005)
- Water Resources Management for Senior Managers (August-September 2005)
- H&H Core Cadre (August-September 2005)
- Water Resources Management Core Cadre (September-October 2005)
- Instructional Training for Core Cadres

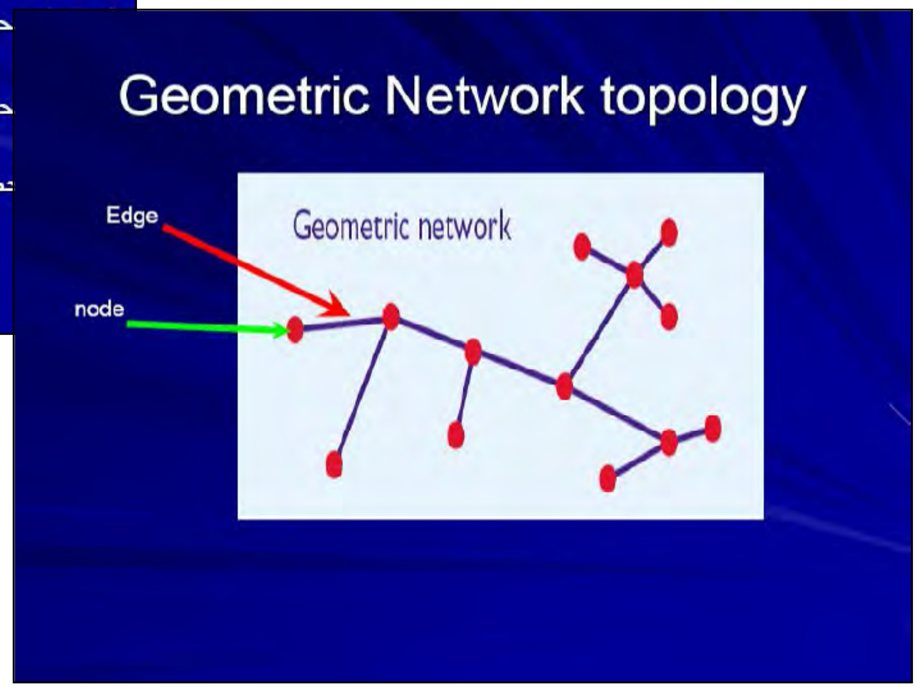
Progress to date

- **Streamgaging training**
  - Supported with equipment and logistics
  - by James Hathorn, CESAM and Steve Lipscomb, USGS
  - Very favorably received by MoWR

Progress…

- **GIS Core Cadre training outcomes**
  - **Mission, vision, goals**
  - **Strategic plan for GIS development**
  - **Preliminary database structure**
  - **Database development plan**
  - **RS, GIS, H&H training**
  - **Web site & poster**
  - **Training materials**
  - **Educational materials**


المحطة الارضية
SV
Corrections
x,y,z,t)
x,y,z,t)
+
Corrections
Control
Station
User
Falcon AFB
Colorado Springs
Master Control
Monitor Station
Hawaii
Monitor Station
Ascension Island
Monitor Station
Diego Garcia
Monitor Station
Kwajalein
Monitor Station
Global Positioning System (GPS) Master Control and Monitor Station Network
حيحات الوقت والموقع ترسل باستمرار الى الاقمار الصناعية
حيحات الوقت والموقع يعاد بثها من القمر الصناعي الى اجهزة الاستقبال
طة الرئيسية تقع في قاعدة النسر الجوية في وادي كلورادو


Geometric Network topology
Edge
node
Geometric network

Way Ahead

- Continue planned training
- Search for additional funding
  - Interim training center at Dokan
  - Unfunded training needs
  - Hydromet gaging critical
- Bright future for MoWR
  - New technology
  - Capability to manage water resources for competing needs
  - Build relationships with technical people in the US